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ABSTRACT

A pilot project has as its goals: to investigate the use of radio for elementary mathematics instruction in underdeveloped countries, to evaluate a prototype system, to develop a methodology for producing radio instructional materials, and to foster in the host country the ability to self-sustain the project. Toward these goals the report cites accomplishment to date: selection of a host country (Nicaragua--Department of Masaya), the steps involved in establishing and sustaining the project in its initial period, and formulation of a schedule for 1974 activities. In addition, the general research plans for the project are outlined. Several related researches in the United States, development of mental arithmetic tests, pilot testing lessons, experiment on digit writing time, and a textbook survey, are described as they relate to the Nicaraguan project. (WH)

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APPLICATION OF RADIO TO TEACHING ELEMENTARY MATHEMATICS IN A DEVELOPING COUNTRY

Barbara Searle

June 30, 1974

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STANFORD UNIVERSITY
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INSTITUTE FOR MATHEMATICAL STUDIES IN THE SOCIAL SCIENCES

STANFORD UNIVERSITY

STANFORD, CALIFORNIA

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INTRODUCTION

In their attempts to improve the quality of primary education, many developing countries face simultaneously a shortage of qualified teachers, especially in the rural areas, and a shortage of funds to support large-scale in-service teacher training. A possible solution to this dilemma lies in the use of television or radio to bring high-quality instruction into the classroom. The use of television to carry a substantial fraction of the teaching burden has been explored in several settings, including El Salvador, Samoa, and Niger. Although radio is used for instructional purposes in many developing countries, there has been little systematic investigation of its effectiveness and of the variables that affect learning from radio in such a setting.

As one step in accumulating research experience with instructional radio, AID has funded the Institute for Mathematical Studies in the Social Sciences (IMSSS) to design, implement, and evaluate, in collaboration with personnel of a developing country, a system of teaching elementary mathematics by radio. The objectives of the project are to:

1. develop and test a cost-effective prototype system of radio mathematics instruction for elementary grades in a less developed country (LDC) that could, with minor adaptations, be used in many LDCs;

2. develop a methodology for producing radio instructional materials based upon the rapid and specific reporting of previous student performance back to the materials developers;

3. begin a program of research on major variables affecting learning through radio;

4. help build capabilities in an appropriate LDC host institution that would enable the institution to continue or even expand the project with minimal further assistance from external experts.

The project is designed to operate in several stages. During the first stage, which occupies the first funding year, the project was to make contact with possible LDC sites and to refine the project design through work with LDC educators. The specific objectives of the first year, as presented in the IMSSS contract with AID, are summarized in the following list.

1. The contractor will assist A.I.D. in selecting an appropriate primary and a possible secondary site for the project.

2. After site selection, the contractor will establish cooperative working relationships with the appropriate host-country government and education officials.

3. After site selection, the contractor and appropriate host-country personnel will cooperate in developing a more detailed research design.

4. A tentative, broad outline of the radio instructional material will be drawn up for the first six years of elementary school based upon the existing host-country mathematics curriculum.

5. In order to develop an efficient mode for recording and collecting young children's written responses, the contractor will perform preliminary experiments in elementary schools around the Stanford University area.

6. The contractor will have primary responsibility for recruiting a project manager who will reside in the host country for the duration of the project.

7. AID, in conjunction with the contractor, will establish an advisory board during this first year of the project.

8. The contractor will establish linkages with related educational technology projects operating in other developing countries.

This report describes the activities and accomplishments of the project staff towards meeting these objectives and discusses plans for the next project year, during which the staff will be expected to set up the project in a developing country and to develop and test instructional materials for first grade.

PROJECT CALENDAR

July 1, 1973 to June 30, 1974

September 5 - 19	Trip to Southeast Asia
November 8 - 20	Trip to Latin America
January 6 - 21	Trip to Latin America and Africa
February 1	Project director hired
February 8	Site selection meeting with AID officials held in Washington; Report on trips, "Site Selection Process: Radio Mathematics Project" distributed.
February 11	Nicaragua selected as first choice for project site
March 6 - 15	Staff visit to Nicaragua for further negotiations
April 1	Agreement between AID and Nicaragua formalized
April 1 - May 10	AID orientation and language training for Stanford staff moving to Nicaragua
June 1	Radio specialist hired
June 9 - 25	Staff arrival in Nicaragua
June 21	Project Research Review Committee meeting

SITE SELECTION

The AID office supervising the project, the Technical Assistance Bureau (TAB) in the Division of Education and Human Resources, organized the initial stages of the site selection process by informing each of the appropriate AID Missions around the world about the project and soliciting expressions of interest from the country and the Mission. We planned to visit each country that expressed interest in the project.

TAB described the project to 42 missions and received positive replies from 12 countries, far more than had been anticipated. We planned three trips: one in September, 1973, to South Vietnam, Thailand, Indonesia, and the Philippines; a second in November to Panama, Colombia, Ecuador, and Peru; and a third in January 1974, to Nicaragua, Brazil, Swaziland, and Nigeria. The visiting team consisted of Barbara Searle from Stanford, David Sprague from TAB, and for the first two trips, Patrick Suppes, and for the third, Jamesine Friend, both from Stanford. In each country initial arrangements for appointments and visits were made by a member of the AID Mission. In some cases, follow-up appointments were made for the visiting team by host-country officials during the course of the visit. The team spent from two to four days in each country.

Prior to each trip members of the Stanford staff gathered background information about each country and talked with members of the Stanford community who are natives of, or have had professional experience, in each of the countries to be visited. We found conversations with staff and students in the Stanford International Development Education Center (SIDEC) particularly useful. Many of the students hold positions of

influence in their own country, in the Ministry of Education, and other branches of the government. SIDEC staff members have considerable experience working overseas, especially in Asia. Several staff members of the Institute for Communications Research have worked extensively in Latin America, and provided us with much useful information. The Center for Research in International Studies proved to be a good source of information about the Philippines, where two staff members have worked in rural schools.

Before the first trip we prepared an extensive outline of the type of information we wanted to obtain about each country we visited. The outline, "Notes on What To Look for When Visiting a Potential Host Country," appears in Appendix A. The visiting team found that its visits were too short to investigate more than a few of the issues raised by the outline, and that a short, more focused list was more useful. The list developed by the team during its travels was also used for comparing countries after the completion of the trips; it is shown in Table 1. The original outline remains a useful guide to the type of information about the host country that must be collected during the course of the project.

The visiting team found that coming to a country prepared with a written list of questions increased the probability of gaining the information needed to make a site selection decision. Although the time spent in each country was generally adequate, the team found that the combined impact of hosts with special interests and activities to describe, time and culture changes, and the wealth of topics and issues to be considered, conspired to memory lapses. An embarrassing example is the team's failure to inquire in Thailand about the extensive school-broadcasting program in operation there.

TABLE 1

Factors Comparing Prospective Project Sites

Response of country
Did officials of the country express interest in having project come to their country and providing financial support for it?

Radio transmitter
Does country have a transmitter available and can we use it?

Suitable schools
Can accessible rural schools be found and used as experimental schools?

School language
Are children taught in their native language? Instruction in other than the native language is a disadvantage.

Curriculum writers
Does country have a pool of trained curriculum writers, some of whom would be available to the project?

School liaison workers
Does the country have a pool of experienced teachers or supervisors who could conduct field work, some of whom would be available to the project?

Site identified
Were we able during the course of our visit to identify a site for the project?

Recording studio
Does country have a recording studio available and can we use it?

Math curriculum
Has the country produced a revised primary mathematics curriculum? A revised curriculum is an advantage.

Development level
How developed is the country? Too much and too little development are both unfavorable.

Size of country
How large is the country? Small countries are preferred.

TABLE 1 (continued)

Office space
Will the country provide office space for the project?

Vehicles
Does country have vehicles that can be made available to project?

Computer
Does country have a computer facility? Is computer time free, or available for rent? (free use is more favorable)

Radio technicians
Does country have radio technicians and can some be made available to project?

Computer technician
Does country have computer programmers and can one be made available to project?

Researchers
Does the country have an educational research institution or a cadre of research workers, some of whom would be available to the project?

Response of Mission
Is the Mission supportive of the project and are they willing to make a financial contribution?

University link
Is there a university primary education department we can establish a relationship with?

Regional ties
Is there a regional organization with whom we can establish linkages?

How far to Stanford
How much traveling time is involved in getting to Stanford?

Time change
How much time change is there between country and Stanford? (This and the previous factor reflect the difficulty of communicating with Stanford.)

Ease of language
How much difficultly might the Stanford staff have learning the language?

Normed tests
Does the country have any national normed tests? Having tests available is an advantage.

The activities of the visiting team and the information obtained during the country visits have been described in a report prepared in February, 1974, (Searle, 1974) prior to final site selection.

Role of Country Visits in Site Selection Process

As described in Searle (1974), several criteria for site selection, among the many that we were able to identify, came to dominate the team's thinking about choosing an optimum site for the project. It is important to emphasize that this relative ranking of criteria was determined by the character of the research effort proposed. By considering in detail how the project might be implemented in different settings, we changed our viewpoint about the relative importance of factors. We will illustrate this point by discussing three selection criteria; (a) the language of instruction, (b) the size of the country, and (c) the 'typicalness' of the country.

A major aim of the present project is to assess the feasibility of delivering the main core of instruction (in mathematics) by radio. A minimum prerequisite in this effort is that the children be able to understand the language spoken by the radio instructor. Although recognizing that in many parts of the world school instruction is not in the native language of the children, the team was not fully aware at the outset of its travels of the extent to which, in such situations, lower primary grades are taught in a local language while the children are being taught the instructional language. Some of the difficulties presented by instruction in a second language are discussed in Searle (1974). A possible solution, broadcasting in the local language, would probably mean that Stanford staff would have to learn two new languages. In addition, it

would probably prove difficult to make a satisfactory decision about the level at which to change languages. It became clear to the team as it traveled that many difficulties could be avoided if the project were to be located in a country in which the children are taught in their native language. Ultimately, it would be feasible to present radio lessons in local languages, using local radio stations (to cope with the use of different languages in different parts of a country). For our research purposes, it seemed important to keep language problems to a minimum.

A major motivation for undertaking research on the delivery of instruction by radio is the challenge of bringing modern, effective instruction to children in large, remote areas of heavily populated developing countries. The examples of Indonesia, with its hundreds of islands, and Brazil, with the remote Amazon basin so isolated from major urban areas, come immediately to mind.

The project staff expected, before making any trips, to locate the project in one of the large developing countries that might be expected to find especially useful the results of the contemplated research. However, among the requirements for carrying out the research was the availability of trained host-country people who could work with the project at the experimental site, supervise in schools, write curriculum, analyze data, and so on. In addition, the project planned to use local computer facilities, maintain close ties with the Ministry of Education, and establish working relations with University professors. All of these require proximity to a major population center (in most countries, the capital).

Under the impact of visiting the large countries it became clear that it would be difficult to carry out the research in the type of area

that might be a prime target for the results of the research. Once this was recognized, the team examined more carefully the prospect of working in a small country. Among the advantages of a small country are a smaller bureaucracy to deal with, shorter distances to travel, and easier communication within the country and among the various parts of the education sector. As a result of all these considerations, preference shifted from a large country to a smaller country.

The third change in thinking occurred as a consequence of the second. As the project staff gave more serious consideration to choosing a small country, the concern about being able to apply the results of the research to other countries increased. Thus, it became important that in some sense the country chosen be 'typical' of a larger group of countries. Although Nicaragua, the country chosen, is in some obvious ways similar to other Latin American countries, we will need to consider quite carefully the characteristics that relate to implementation of the proposed radio broadcasting system so that we will be in a position to make predictions about transferability to other countries, in Asia and Africa, as well as in Latin America.

Having the opportunity to visit many countries and to discuss the project with host-country officials resulted in major changes in the thinking of the Stanford staff about the question of site selection. In addition, the challenge of defending the project in these diverse settings sharpened our thinking and refined our plans.

However, the country selection procedure used had the drawback that country expectations about obtaining the project were raised as a result of the visit. The visiting team found that a useful technique for structuring discussions with host-country officials was to explore

in detail exactly how the project might be implemented in the country being visited. Although the team stated early in each visit, and repeated often, the tentative nature of the discussions, and emphasized that many countries were being visited, nevertheless, specific, detailed discussions gave the impression of actually making arrangements. At least two countries expressed to TAB, through their Missions, great disappointment in not being chosen, apparently reflecting prior expectations. It is not clear how often, and under what circumstances, this method of site selection should be used. The advantages to the contractor, especially one who has not had extensive experience working overseas, are great. However, the difficulties imposed on the prospective countries are also worthy of serious concern.

Selection of Nicaragua

The choice of a location for the project grew out of extended discussions among the staff about the results of the country visits and out of attempts to systematically compare the countries on a wide variety of characteristics relating to project goals and organizational requirements. A comparison of the twelve countries on thirty such characteristics appears in the Matrix of Country Comparisons in Searle (1974).

A list of the factors considered during the country selection process is shown in Table 1. The factors are presented roughly in order of relative importance for site selection, as judged by the Stanford staff. The twelve prospective countries were compared, resulting in the choice of Nicaragua as a suitable site.

The factors given greatest weight were the response of the country (interest in the project, willingness to commit resources to it), the availability of radio-transmitting facilities, the availability of

suitable schools, and the use of the native language in schools. The first three factors were necessary conditions for the operation of the project; the fourth has been discussed above.

Three factors rank next in importance. Two concern the availability of trained host-country people to work as curriculum writers and school liaison workers. The third concerns the question, "Was the visiting team able, during the course of the visit, to identify a site for the project and discuss details of implementation?" This factor was used to assess the concreteness of discussions with host-country officials. The visiting team found that it was much easier in some countries than others to focus discussion on specific details of the project: Where would it be located? Which radio station would be used? Where were computer services available? The factor was rated highly to reflect the staff opinion that it would be easier to establish a working project in a setting in which officials seemed able to deal quickly and easily with the actual details of implementation.

Four factors were considered of medium importance. The absence of recording studio facilities could be compensated for by project-purchased equipment, although we would prefer not to do so. The presence of a revised mathematics curriculum would be an advantage to the project because it would mean that less curriculum development work would be necessary, that teachers would be confronted with less change, and because it would increase the probability of our finding host-country people trained in curriculum development work. The 'development level' factor reflects a preference of the staff for working in a country that is neither too little nor too much developed. This subjective factor concerns mainly the level of sophistication and training of people involved in

research, curriculum development, and use of instructional media. In order to function effectively the project must have available to it the services of some people with the requisite skills; at the other extreme, we feel our contribution to the host country itself would be smaller in a situation (for example in the Philippines or in Brazil) where many highly trained people are already at work in the fields of instructional radio and educational research. The 'size of country' factor has been discussed above.

Table 2 shows how Nicaragua was rated on the eleven most important factors. (The remaining factors listed in Table 1 were considered to be of less importance for selection.) The ratings in Table 2 reflect knowledge of the situation in Nicaragua at the time of site selection; subsequent negotiations assured the availability of all facilities essential for operation of the project.

On February 11, 1974, the Stanford staff communicated to TAB its intention to explore further with Nicaragua the feasibility of locating the project there. An English version of the letter written to the Minister of Education of Nicaragua, Jose Antonio Mora Rostran, concerning the decision of the Stanford staff is reproduced in Appendix B. The letter expressed our interest in pursuing the possibility of locating the project in Nicaragua, and asked for the opportunity to return and talk with the Minister and other officials. The Minister stabled his agreement and plans were made for a return visit in March. The negotiation team was composed of Jamesine Friend, who had in the interim been appointed Project Director, Thomas Tilson, a staff member from the start of the project who will also work in Nicaragua, and Barbara Searle, campus coordinator of the project.

TABLE 2

Rating of Nicaragua on Important Country-Selection Factors

February, 1974

Factor[a]	Rating	Justification
Response of country	High	Ministry of Education enthusiastic; cooperation pledged.
Radio transmitter	Medium	Must use private radio station; not certain that arrangements could be made.
Suitable schools	High	Department of Masaya has suitable rural and urban schools.
School language	High	Spanish used everywhere.
Curriculum workers	Medium	Several experts in Ministry of Education; not certain that they would be assigned to project.
School liaison	Medium	There are many unemployed school teachers, almost no one with research experience.
Site identified	High	Yes, Department of Masaya. Preliminary discussions carried out with Inspector of the department.
Recording studio	Medium	See comment for radio transmitter.
Math curriculum	High	Curriculum completely revised within the past six years.
Development level	High	No government-sponsored educational radio, almost no educational research, good curriculum development efforts.
Size of country	High	Nicaragua small, but not atypical.

[a] The factor labels given here are discussed in the text and described more fully in Table 1.

Negotiations with Nicaragua

The letter from IMSSS to the Minister of Education of Nicaragua stressed that we needed further information in order to make a decision about locating the project there. We were particularly concerned about the availability of staff members and the necessity for making firm arrangements about the use of radio-transmitting and recording facilities. In addition, many other details needed attention. A list of the questions that needed to be answered was prepared prior to the visit, and that list, with the answers obtained, can be found in Appendix C.

Upon arrival, the team found that the Minister had appointed Mrs. Vitalia R. Vrooman, an expert in the development of primary mathematics curriculum, to work with the team during its stay, and if we chose Nicaragua as a site, she was to become a permanent member of the staff. Mrs. Vrooman organized details of the visit and served as a translator where necessary.

The team spent ten days in Nicaragua and after three days decided that the Ministry would be able to meet satisfactorily the requirements for personnel and radio facilities, and they made a firm decision to locate the project there. They informed David Sprague, Project Manager for AID, of this decision, and he joined the team for the last two days of the visit. The team and Ministry officials agreed on the use of the Department of Masaya as a local site for the project. (The choice of Masaya is discussed in the next section of this report.)

During its stay in Nicaragua, the team visited the office of the Inspector of the Department of Masaya and discussed many details of implementation with the Inspector. He expressed his interest in the

project and agreed to support efforts to gain teacher acceptance and cooperation, initiate testing programs, and cooperate with teacher-training efforts. The team visited classrooms to observe first- and second-grade mathematics classes. They conferred with the staff of the Research and Evaluation Office and and met with the staff of the Audio-Visual Aids office, both in the Ministry. They visited the computer centers of the Central American University (UCA) and the National University, and made tentative arrangements to use the IBM 1130 located at UCA.

The team discussed staffing requirements with the Minister and the Director of Planning, Dr. Raul Quintanilla, under whose aegis the project falls. Two curriculum experts, in addition to Mrs. Vrooman, were assigned to work with the project, and the Minister agreed to make three teachers available as soon as they were needed.

The team met with members of the AID Mission to discuss the Mission's role in the project and in the establishment of an AID contractor in the area. Mrs. Friend and Mr. Tilson explored arrangements for living in Nicaragua and providing schooling for their children.

At the request of the Minister, the team prepared a brief summary of the project that was translated into Spanish. The visit culminated in a meeting with the Minister during which initial agreement was obtained about the allocation of responsibilities between Nicaragua and AID. Final agreement was not reached at that time, primarily because of time pressure. David Sprague returned for a brief visit at the end of March, and together with Peter Tobia, Chief of Human Resources for the A.I.D. Mission, concluded an agreement with Minister Mora and Dr. Quintanilla. That document is contained in Appendix D.

The Minister agreed to have Mrs. Vrooman and the other two

prospective staff members work part time for the project during the interim period before the Stanford staff arrived. The Nicaraguan and Stanford staff together made plans for administering achievement tests in mathematics to first and second graders, and left the Nicaraguans with the task of developing appropriate tests. The Nicaraguan staff members also agreed to collect information about schools in Masaya, and to oversee the preparation of the promised office space. Plans were made for the arrival of Mrs. Friend and Mr. Tilson in early June.

Choice of the Department of Masaya

The use of the Department of Masaya as an experimental site was suggested to the site selection team during its visit to Nicaragua. Masaya has an area of about 210 square miles and is located approximately 30 miles east-southeast of Managua. Among the advantages cited for choosing the department were proximity to Managua, the presence of a compact and relatively large population in and around the town of Masaya, and an energetic School Inspector who welcomed change and took an active role in promoting it. The choice of Masaya was discussed with the Minister of Education, who was enthusiastic about having the project come to Nicaragua, and who assured the team that education officials in the department would cooperate with project staff.

The visiting team investigated the services available in the Masaya area and in nearby Managua. They were able to identify and obtain the assurance of availability of (a) office space, (b) a radio station, (c) recording facilities, (d) a computer facility, (e) printing facilities, and (f) potential staff members. They were also able to obtain some information about the characteristics of Masaya schools.

Data for 1971 on the number of schools and classrooms in Masaya are presented in Table 3. Urban schools are, on the average, larger than rural schools. The extent to which children of different grade levels are taught in single classrooms is indicated in Table 4. More than a third of the rural classrooms have more than two grades being taught simultaneously, while this is true of fewer than 1 percent of the urban classrooms. A comparison of Tables 3 and 4 shows that some classrooms are used for double sessions, and that this double usage is almost entirely urban. The number of pupils at each grade level, for urban and rural students, is shown in Table 5. The extremely sharp decrease in number of rural students is apparently partly attributable to the fact that rural schools contain only two or three grades, and, because of the compactness of the department, students wishing to continue can reach schools nearer town (which are thus characterized as urban) without too much difficulty.

A question of some interest is how typical the schools of Masaya are of the country as a whole. The department of Masaya is compared with the whole of Nicaragua for several indices in Table 6. Although teachers seem to be somewhat better trained (probably a reflection of the proximity to Managua) and a higher percentage of rural children attend school the department is, in most respects noted in the table, typical of the country.

TABLE 3

Number of Schools and Classrooms in Masaya in 1971

	Number of schools	Number of classrooms
Urban	51	245
Rural	66	118
Total	117	363

TABLE 4

Extent of the Use of Combination Classes in Masaya in 1971

	Number of classrooms			
	one grade taught	two grades taught	three or more grades taught	total
Urban	319	10	2	331
Rural	63	13	47	123
Total	382	26	49	454

TABLE 5

Number of Pupils per Grade

Department of Masaya, 1971

Grade	Urban	Rural	Total
Preprimary	70	75	145
1	3,477	2,991	6,468
2	2,153	1,230	3,383
3	1,864	768	2,632
4	1,599	380	1,979
5	1,475	192	1,667
6	1,247	94	1,341
Total	11,885	5,730	17,615

TABLE 6

Comparison of Masaya and Nicaragua

Index	Masaya	Nicaragua
Percentage of rural children in school	83	68
Percentage of certified teachers	94	79
Percentage of classrooms with		
one grade	84	79
two grades	5	5
more than two grades	11	16
Pupil-teacher ratio	35	38
Percentage of school children in		
Preprimary	.8	2.7
Grade 1	36.7	36.6
Grade 2	19.2	19.0
Grade 3	15.0	14.9
Grade 4	11.2	11.5
Grade 5	9.5	8.6
Grade 6	7.6	6.7
Percentage of illiterate adults (1970)		
Urban	21.1	16.6
Rural	57.0	62.5

Note.-- Data is for 1971 unless otherwise noted.

ESTABLISHMENT OF A WORKING PROJECT IN NICARAGUA

Stanford project staff members arrived in Nicaragua during the latter part of June, 1974. At the time of the preparation of this report the staff in Nicaragua was establishing project offices, recruiting staff, and arranging for the use of recording and computing facilities. Three activities will dominate staff efforts for the remainder of the summer; developing and administering tests of student mathematics achievement, gathering data on schools and students, and selecting classes and preparing lessons for pilot testing.

Design of preliminary versions of mathematics achievement tests appropriate for midyear first-grade students was completed by the Nicaraguan staff during May. After revision, these tests will be administered during the summer, and will provide staff with information for deciding at what level to begin instruction.

A preliminary plan for the development of radio lessons has been drawn up and will be field-tested during July and August. The project faces a heavy production schedule, and developing an efficient, workable plan for production tasks has high priority. A series of flowcharts describing the production plans are displayed and discussed in Appendix E.

A schedule of project activities planned for the remainder of 1974 is shown below.

1974 - General Activities

June 15

Begin project operations in Nicaragua.

July 1 - December 31

Hire remaining staff members (three have already been assigned to the project).

Organize project office.

Establish working relationship with MEP and departmental officials.

Establish procedures for collecting information about students (attendance, school record, SES measure, if possible).

Arrange for writing and debugging of computer programs for collecting and analyzing data.

Collect data necessary for defining a rural-urban scale.

1974 - Activities for Grade 1

June 15 - August 1

Design a test of entry-level skills for midyear first graders (preliminary work is being done by Nicaraguan staff prior to June 15).

Administer the test of entry-level skills to at least 20 first-grade classrooms distributed among schools in different locations.

Choose six classes for pilot testing from among those tested, representative of different locations.

Start teacher training for teachers of pilot classes.

Start writing and recording lessons to be pilot tested.

August 1 - November 30

Start pilot testing, one lesson per week at first, then two, increasing to five lessons per week.

Continue writing and recording lessons until 50 have been completed.

Design and conduct small experiments (for formative purposes) using taped lessons.

Collect and analyze response data from students taking pilot lessons.

Observe pilot classes during lesson presentations.

Continue working with pilot class teachers.

Write a progress test for pilot class students.

Write a year-end test for pilot class students.

Late November

Administer year-end test to pilot class students.

Carry out experiment using taped and live tests.

December

Continue analysis of response data.

Prepare recommendations for revision of first-grade materials.

1974 - Activities for Grade 2

September - October

Design year-end test for first-grade students in conventional classrooms to be used as a rough measure of entry-level skills for second graders.

Early November

Administer year-end test to at least 20 conventional first-grade classes, distributed by location.

December

Begin planning radio lessons for Grade 2.

SUMMARY OF RESEARCH PLANS

Preliminary research plans for the project have been developed by the staff and are described in Searle, Friend, Jamison, Suppes, Tilson, and Zanotti (1974). The plans fall into several broad categories including planning research, evaluation of the instructional program, cost-effectiveness evaluation, developmental research, and evaluation of other project outcomes.

Planning research will focus on the collection of information about characteristics of the schools and communities of the Department of Masaya, about the geography of the department, and about characteristics of the population.

In order to facilitate evaluation of the instructional system, the development and testing of curriculum materials for each grade level will be carried out in three phases. Phase A will include pilot testing in a small number of classrooms (approximately six) using tape recorders to present lessons. Prior to lesson design, children at the appropriate grade level will be tested to measure entry-level skills. The information obtained will be used in scheduling the instructional content for the year and in planning the initial broadcasts. The pilot testing schedule will be the same as the contemplated broadcast schedule. Each class will hear lessons in sequence and at the appropriate time in the school year. Teachers will be trained to assist during the taped lessons and response sheets will be collected daily for immediate scoring and analysis. Summary results of student performance will be prepared for use by lesson developers. Frequent classroom observations and conferences with participating teachers will supplement analysis of student response data.

Experiments using parallel lessons may be conducted, and all materials will be subject to extensive change. Lessons will take from two to four weeks to produce; thus, on a regular basis, performance data can influence the design of the next month's lessons, or earlier on an emergency basis. The development of tests for measuring achievement will begin during Phase A and continue through Phases B and C.

Phase B will include both formative and summative evaluation tasks. Lessons will be rewritten and retaped, and auxiliary materials will be redesigned where indicated by the results of pilot testing. Lessons will be broadcast to a large number of classrooms (approximately 45), which will be part of a larger experimental design. The teacher-training program will build on the experience of the pilot testing phase and data collection schedules will be redesigned to accommodate the increased number of schools. All experimental classrooms will receive the same broadcasts, but postbroadcast activities may be modified experimentally, allowing comparisons of the effectiveness of different types of teacher activities. Data for guiding the final revision of lesson materials will be gathered, and a preliminary assessment of the effectiveness of the program, using experimental and control classes, will be possible.

By Phase C, the third year for development of curriculum materials, the radio lessons and student and teacher supplementary materials are expected to be relatively stable, and a full summative evaluation of the instructional program will be conducted. Some experimentation may also be carried out on aspects of the program not related to materials, such as teacher training and data collection procedures.

Parallel to the three-phase development of instructional materials,

instruments will be developed for measuring other outcomes, for example, attitude changes and the response of teachers to using the radio programs. Student attendance records, educational costs, and other types of data will be collected.

The cost-effectiveness component of the project evaluation effort will assemble empirical data and undertake analyses that will provide information relevant to:

1. Decisions concerning the evolution of the Stanford project;
2. Decisions that the Nicaraguan Ministry of Public Education will make concerning whether and how to expand use of radio throughout the elementary school system; and
3. Decisions that other developing countries and donor agencies must make concerning whether and how to use radio in formal school systems.

Three interrelated tasks will comprise the cost-effectiveness evaluation. First, we will construct a simulation model of the elementary-education system in Nicaragua that will project numbers of graduates, dropouts, and enrollees, as a function of budget levels, dropout rates, repetition rates, their present determinants, and the impact of radio on them. Second, we will undertake an empirical analysis of the determinants of dropout and repetition rates. Third, we will assemble cost information on radio and the traditional system.

Developmental research will center around the analysis of student response data. These data will provide information to curriculum developers about student performance and will form the basis, along with classroom observations, for systematic design and revision of curriculum materials. For this purpose, item analyses will be performed on a regular basis, using computer facilities in Nicaragua. Further analyses of a more extensive nature will be conducted at Stanford University, using the IMSSS

computer facilities.

We will use the response data to provide information to curriculum developers and also to deepen our knowledge of the curriculum. Building on work already in progress at IMSSS, we will study student trajectories through the curriculum, with the aim of increasing the ability to predict, from intermediate performance scores, both terminal performance and appropriate remedial measures for increasing terminal performance.

Some possible project outcomes which are difficult to quantify are nevertheless of interest to the staff. Among these we will be especially concerned with finding indications of the institutionalization of radio instruction by the Government of Nicaragua, with building Nicaraguan technical and research capabilities and with the generalizability of project outcomes to other countries and other school subjects.

OTHER PROJECT ACTIVITIES

Development of Mental Arithmetic Tests

Mental arithmetic tasks will form a large component of the curriculum for the Radio Instructional Program (RIP). Proficiency in mental arithmetic is a useful skill in any cultural setting, but it seems especially so in a developing country that does not have a tradition of paper-and-pencil use. Because the radio is uniquely suited to instruction in mental arithmetic, these skills will be stressed in RIP. In reviewing the literature on mental arithmetic, we found few quantitative studies and no standardized tests, and thus we have undertaken to develop tests to assess mental arithmetic skills. These tests are being normed in the United States, and will later (probably in the Spring of 1975) be adapted for use in Nicaragua, and normed there. We give here a brief description of this work. A full report covering test construction and norming will be prepared at the completion of the work on primary-level tests.

The first step in the development of tests was to construct a mental arithmetic curriculum; test items are then obtained by sampling from the curriculum as described below. The curriculum is an adaptation of a portion of the Mathematics Strands Drill-and-practice Course developed at the Institute for use in computer-assisted instruction. In that course the mathematics content appropriate for Grades 1 through 7 is divided into 14 strands, each covering exercises of a single topic. The exercises of a single type within a strand constitute an equivalence class. Each equivalence class has an explicit definition in terms of the format of the exercise, the operation used, the size of the numbers involved, and so on. This same structure has been preserved in the mental arithmetic

curriculum, with material distributed among 7 of the 14 strands appropriate for oral presentation, addition, subtraction, number concepts, multiplication, division, measurement, and fractions.

Three levels of tests are being developed. The primary level--three tests suitable for Grades 1 through 3--is complete, and work is in progress on the intermediate level--for Grades 4 through 6--and the advanced level--for Grades 7 and 8. Each test consists of a set of 100 or 110 exercises, presented using a prerecorded tape. Students respond on prepared answer sheets and written free-response answers are expected. Students are instructed to write only answers, not problem statements, on their papers.

The test at each grade level covers items with probability correct (P) ranging from 0 to 1, avoiding a floor or ceiling effect. The exercises are ordered by difficulty level (as determined by pretesting), with the easier ones appearing early. Thus, a student's grade equivalence score roughly corresponds to his 'quitting' point. We found that with this test structure, students are more likely to give their full attention and effort to exercises that they are able to do. It is unlikely that an item that a student can do will be embedded in a group of items he cannot do.

Construction of the primary tests was carried out as follows.

1. A set of equivalence classes was identified that contained material appropriate for Grades 1 through 3. Three of the seven strands were represented: addition, subtraction, and number concepts.

2. Performance data were obtained for exercises sampled from these classes, and the data were used to establish an ordering of classes, from least difficult to most difficult.

3. For each grade level, an interval along the resulting continuum of ordered classes was chosen with the proper boundary conditions, that is, P close to 1 at the left and

P close to 0 at the right. The resulting intervals for the three grades have large regions of overlap.

4. For each grade, the universe of equivalence classes in the interval was divided into nine strata that represent three types of addition problems, three types of subtraction problems, and three types of number concepts problems. (This was done to make possible the imposition of a distribution on problem types within a strand.)

5. A family of tests for each grade level was defined by the number of equivalence classes from each stratum, as well as the range of classes. With this constraint on the distribution of classes, the particular equivalence classes from each of the strata were chosen at random from the set of all possible equivalence classes in that stratum for that grade.

6. A test was then constructed by randomly generating one exercise from each of the selected equivalence classes.

For our purposes two parallel test forms were constructed using this procedure.

The distribution of equivalence classes among strata for the mental arithmetic curriculum and test are shown for Grade 1 in Table 7. There are a total of 46 classes in the number concepts strand at the first-grade level, 11 in the first stratum, 15 in the second, and 20 in the third. Five classes are sampled from each stratum for the test, and thus 15 percent of the test items are from number concepts classes. Classes from the addition and subtraction strands are similarly distributed among strata, and comprise, respectively, 52 percent and 33 percent of the test items. The rationale for the distribution described in Table 7 will be discussed more fully in the forthcoming full report on this work.

During the spring of 1974, the primary tests were administered at six schools representing three socioeconomic strata (SES) (low, middle, and high) within the San Francisco Bay area. Students in Grades 1, 2, and 3 received the two parallel forms of the oral arithmetic tests and one

TABLE 7

Distribution of Equivalence Classes Among Strata

Mental Arithmetic Curriculum and Test

Primary - Grade 1

Strand	Stratum	Number of Classes: Defined for strand	Sampled on test	Proportion of test items
Number Concepts	1	11	5	.05
	2	15	5	.05
	3	20	5	.05
	Total	46	15	.15
Addition	1	44	26	.26
	2	25	13	.13
	3	23	13	.13
	Total	92	52	.52
Subtraction	1	24	20	.20
	2	19	7	.07
	3	7	6	.06
	Total	50	33	.33
	Grand Total	188	100	1.00

Stanford Achievement Test (SAT). Grades K, 4, and 5 received only the two oral arithmetic tests. The written SAT was administered in order to compare the oral score with the score on a well-known standardized test.

The norming procedure involves determining 'grade equivalent' scores for each grade on each of the three primary level tests. Such grade equivalents are derived by finding the median student score, that is, the score of the student above which 50 percent of the students' scores fall. It was not possible either to give all the tests to students at all grade levels, nor to spread administration of the tests across a school year. The techniques used to make inferences about student scores in cases where tests were not given are discussed in the forthcoming report.

The grade placement will be computed by weighting the contribution of a score of a given student based on the relative proportion of scores obtained from his SES level. Thus, if there are twice as many high SES students who took the test as low SES students, each high SES test would contribute half as much weight as a low SES test. In this way, we are able to equalize the contribution of high and low SES groups, regardless of the number of students attending these classes. Had there been equal numbers of students in each SES group, a given grade placement would be the median score of students for that grade. In our case, the grade placement will be found in a cumulative frequency distribution of scores where one axis represents the score, which is the average of scores from the two test forms, and the other the cumulative frequency of responses weighted as described above. The grade placement is then that corresponding to the 50th percentile.

Pilot Testing Lessons in a Local School District

During April and May, 1974, five radio mathematics scripts were produced and pilot tested in a local elementary school. The testing had two purposes: we wanted to acquire some firsthand experience with the recording process and other procedures entailed in the preparation of a radio script for lesson administration. We also wanted to investigate on a preliminary basis some of the variables characterizing lessons, such as appropriate length for response times, optimal format for the worksheet, logistics of oral presentation, and the responses of children to different methods of presentation of material. Although we recognize that there may be many differences between children in California and in the Nicaraguan schools, and therefore limits to the generalizability of the results, the staff believed that the trial run through the entire process of production and the information thereby obtained would be useful. A brief report of this work is presented here. A full report, now in preparation, will be issued separately.

Five radio scripts varying in length between 15 and 20 minutes each were written, recorded, and played (using cassette tape recorders) in two kindergarten and two first-grade classes in a middle-income elementary school in Campbell, California. The lessons were designed and written by project staff; recording and administration of lessons were carried out under staff supervision by Stanford undergraduate students. In the classroom, one Stanford student played the role of teacher; another served as an observer. Children listening to the taped lessons responded on prepared answer sheets. Observational data and student responses were collected and analyzed.

Lessons were constructed from lessons segments covering

the topics of Dictation, Counting Pictures, Counting Sounds, Memory, Greater and Less Than, and Story Problems. The distribution of exercise sets among these topics is shown in Table 8. The table indicates whether student responses were written or oral and whether or not the exercises were given for follow-up work after the taped lesson was completed. Exercises not so marked were given during the lesson.

The time required to prepare each lesson, including typing the script, recording scripts, and producing worksheets and cassettes is shown in Table 9. We estimate that the time taken to prepare the fifth lesson, 13 man-hours, is an upper limit to the number of man-hours necessary to prepare radio scripts in the future.

Administration of each lesson was carried out by two persons, one acting as the 'teacher' and the other as an observer. Questionnaires were distributed to both for each lesson. A separate questionnaire was given to the classroom teacher at the conclusion of the fifth session. All worksheets were collected and statistical analyses were carried out on the students' responses.

The material covered in the lessons was geared toward mid-year, first-grade students. It was consequently expected that the kindergarten students would find the lessons difficult, whereas the first-grade students would find them relatively easy. We found this to be the case. Table 10 exhibits summary performance data. For each grade, means and variances were found for each exercise set. The mean and variance of these means are presented in Table 10. The means for first-grade students are higher than for kindergarten students, as expected. However, the variances of kindergarten children were greater than the

TABLE 8

Distribution of Exercise Topics Over Lessons

Topic	Lesson				
	1	2	3	4	5
Dictation	D1: 5 probs, written	D2: 5 probs, written	D3: 5 probs, written	D4: 5 probs, written	
Counting pictures	CP1: 5 probs, written, follow-up		CP2: 5 probs, written		CP3: 5 probs, written
Counting sounds		CS1: 8 probs, oral	CS2: 10 probs, written	CS3: 5 probs, written	CS4: 5 probs, written
Successors	S1: 5 probs, oral S2: 5 probs, written	S3: 5 probs, written follow-up	S4: 5 probs, written follow-up	S5: 5 probs, written	S6: 5 probs, written
Memory	M1: 5 probs, written	M2: 5 probs, written		M3: 5 probs, written	
Greater and less than			GL1: 5 probs, written	GL2: 5 probs, written	GL3: 5 probs, written
Story problems		SP1: 5 probs, written		SP2: 1 prob, written, follow-up	SP3: 1 1 prob, written, follow-up

TABLE 9

Time Required for Completion of Task

Task	Man-hours				
	Script 1	Script 2	Script 3	Script 4	Script 5
Typing and preparing script for recording	5.0	5.0	3.5	3.5	2.0
Preparing worksheets and cassettes	3.75	3.25	3.25	3.25	3.25
Recording script	40.5	20.0	8.0	8.0	8.0
Total	49.25	28.25	14.75	14.75	13.25

TABLE 10

Mean and Variance of Section Scores by Lesson

	Kindergarten		Grade 1	
	Mean	Variance	Mean	Variance
Lesson 1	.700	.015	.970	.000
Lesson 2	.668	.009	.944	.002
Lesson 3	.669	.023	.908	.008
Lesson 4	.674	.033	.859	.032
Lesson 5	.760	.002	.902	.003

variances of first-grade children for four-fifths of the analyses. This is probably a result of the ceiling effect present in the high scores of first-grade students.

The kindergarten students had difficulty in working on the answer sheet. Some were unable to put answers in the correct blank, others were confused about writing two-digit numbers horizontally on the worksheet, which was organized vertically. Some students were unable to turn their worksheets over and find the proper response blanks on the reverse side. Others had difficulty responding to sections in which exercises were interspersed throughout the dialogue, rather than being presented successively. Some children scribbled on their worksheets continually during lesson administrations and others redrew the letters and answer blanks on their worksheets.

The observers agreed that for all but one type of mathematical exercise the response time allotted per problem was insufficient to allow the kindergarten children to complete the task of determining the correct response, finding the appropriate blank on their worksheets, and writing down their answer. Also the students were allowed to answer the last set of exercises in each section at their own pace, causing the lessons to terminate in a rather disrupted state.

Kindergarten students were restless during the presentation of exercise sets which required them to listen to dialogue; however, they were attentive when the mathematics problems were presented. Furthermore, restlessness increased as a function of time. It seemed that exercises in which visual stimuli or novel auditory sounds were utilized were enjoyed more by the students.

The kindergarten students responded orally during every

exercise set, with higher frequency in certain sections. They also tended to copy answers.

In contrast to the kindergarten students, the first-grade students found the radio lessons relatively easy. They experienced little difficulty with the format of the answer sheets, one exception being the sections in which they were required to write more than one number in an answer blank. Also, the directions for moving from one column to the next were sometimes not clear; in such cases children had trouble finding the proper column in which to write their answers.

Observers of the first-grade classes concurred that a sufficient number of example problems were presented to the children in all but two sections, and that, in fact, more would have been boring. The response time allotted per problem, with only one exception, was not only adequate, but often more than sufficient. The disruptive termination of the exercises also occurred in the first-grade classes, because of the lack of a fixed time limit for the last exercise set.

A common observation was that the children grew more and more restless as a function of time, which may be attributable to the relatively low difficulty level of the material. Although these students enjoyed the sections in which they counted aloud, as did the kindergarten children, only a few of them responded orally when they were not supposed to.

From this feasibility study we found that the role of the teacher, as we had originally conceived it, was inappropriate. The teacher was instructed to draw a replica of the answer sheet on the chalkboard prior to starting the tape. When the lessons started he was expected to stand at the chalkboard and work the example problems. Thereafter, he was to point at the appropriate place for the student

to respond. We found that the majority of the children did not even look at the chalkboard. The students playing the role of teacher found themselves more useful when they walked around the classroom, helping children individually with difficulties as they arose and preventing them from talking or answering the problems aloud.

The 'teachers' agreed that the directions written on the script concerning the tasks required of them were sufficient. Some, however, felt that the time allotted on the tape to perform these tasks was insufficient when the children were confused or needed individual attention.

Four different methods of reinforcement were employed in the radio scripts, namely, no answer, immediate answer presentation, answer presentation after a pause, and answer presentation after the entire exercise set has been given.

When no answer was provided after a problem was presented to kindergarten children, they tended to lose interest in the script. Further, once they were provided with answers, they tended to expect answers for all of the problems. As a result, they waited for the answer from the tape before writing one down and hence fell behind.

For these children, observers felt that immediate reinforcement is preferable to no reinforcement. One observer of kindergarten classes noted that when an answer was presented on the tape, children wrote it down only if they had not already written an answer; however, if they had already written down an answer, they generally did not check to see if it agreed with the one provided on the tape. The children reacted similarly to the use of reinforcement after a pause.

Reinforcement of an entire exercise set had a deleterious

effect on the kindergarten children. Not understanding the checking process, when the questions were repeated on the tape, they rewrote the answers as they were dictated in the next column on the worksheet, which in turn caused them to be lost and confused for the remainder of the lesson.

The response of first-grade children to reinforcement was quite different. Most of them were able to answer the exercises immediately, and so were indifferent when no reinforcement was provided.

Immediate reinforcement, it was felt by the observers, was better than no reinforcement, but not as desirable as reinforcement after a pause. This latter method was regarded as preferable to immediate reinforcement, for after the pause, children would compare their written response to the answer given, and if is was incorrect, they would change it.

The method the children seemed to enjoy most was receiving reinforcement after an entire exercise set has been presented. They understood the checking process and participated in it enthusiastically, especially when they found that they had answered a question correctly.

Classroom teachers were asked as series of questions concerning the taped lessons. In summary, not only did the kindergarten teachers feel that the scripts were too long and difficult, but they also felt the scripts included too many processes for the children to comprehend and to respond to in the appropriate places in the time allotted. In contrast, first-grade teachers felt that the lessons were too long, too boring, and too easy. Both kindergarten and first-grade teachers felt that asking the children to respond orally was appropriate;

however, the kindergarten teachers noted that once a child is asked to respond verbally, he continues to verbalize.

Experiment on Time Required to Write Digits

In designing the radio lessons described in the previous section we did not have a good estimate of the amount of time children needed to respond to exercises. Such response times have two components, the time required for determining an answer, and the time required for writing it down. To investigate the second question we designed a timed dictation test, which was administered to 22 kindergarten children and 43 first-grade children who had participated in pilot-testing the lessons.

Eight ten-exercise dictation sets were administered by prerecorded tape. Each exercise was simply the instruction, "Write X," where X is a one-digit or two-digit number. The time between presentation of exercises varied from 6 to 2 seconds for one-digit numbers and from 6 to 4 seconds for two-digit numbers. The exercise sets are displayed in Table 11. Each of the first five sets presented all ten digits and varied the order and time allowed for response. The last three exercise sets used, for the most part, five pairs of two-digit numbers with digits reversed, for example, 17 and 71.

Administration of the eight exercise sets was preceded by example problems and directions to students about how to use the answer sheets. The answer sheets were similar to those used for the radio lessons and were thus familiar to the children.

Performance data for the timed dictation tests are presented in Table 12. Kindergarten children were able to respond correctly to two-thirds of the one-digit exercises when these were presented at 6-

TABLE 11

Exercise Sets Used for Timed Dictation Test

Set	Response Time seconds	Numbers Presented									
1	6	2	4	1	8	0	6	9	7	3	5
2	5	6	0	9	2	1	7	8	4	3	5
3	4	4	0	2	5	7	3	9	8	6	1
4	3	2	5	7	1	8	6	4	0	3	9
5	2	2	5	0	1	6	8	3	7	4	9
6	6	28	43	82	91	65	90	17	34	56	71
7	5	65	19	80	71	43	28	56	82	34	17
8	4	91	28	65	56	17	34	82	43	71	30

TABLE 12

Performance on the Timed Dictation Test

Percentage Correct

	Kindergarten		First Grade	
Response times	One-digit numbers	Two-digit numbers	One-digit numbers	Two-digit numbers
6	67	12	98	80
5	61	5	99	69
4	56	8	93	69
3	60		94	
2	51		93	

second intervals and performance dropped off slowly as the time was decreased. They were almost unable to cope with the task of writing two-digit numbers ($p<.13$). First-grade children were able to write one-digit numbers essentially perfectly at 6 and 5 seconds ($p=.99$, $p=.98$), and showed only a slight performance decrement as the time allowed for responding decreased to 2 seconds ($p=.93$).

Performance was somewhat poorer for two-digit numbers. We were interested in the sources of error for these exercises. Table 13 characterizes the errors made by students. Reversals, although they occurred, accounted for only 2 percent of the errors. The number of omissions rose as the time decreased, and accounted for more than half the errors when problems were presented at 4-second intervals. The other errors included a few responses apparently written on the wrong line, and many responses (approximately 1/3 of the 'other' errors) in which one digit was written correctly and the other incorrectly.

The pattern of omissions was approximately the same for the three response times, low at first, building until the seventh or eighth exercise, and then falling. Tentative decisions, subject to further testing in Nicaragua, have been made to allow 5 seconds for responding with one-digit answers and probably 9 seconds for responding with two-digit answers.

TABLE 13

Characterization of Errors on Writing Two-Digit Numbers

First Grade

Response time	Error Type: Omission N[a]	Omission P	Reversal N	Reversal P	Other N	Other P	Total N	Total P
6	34	.08	5	.01	45	.10	84	.20
5	49	.11	12	.03	74	.17	135	.31
4	76	.18	9	.02	50	.12	135	.31
Total	159	.12	26	.02	169	.13	354	.27

[a] N = number of responses
P = proportion or total responses

Survey of First-Grade Mathematics Texts from Ten Countries

The curriculum and methods used for mathematics instruction in developing countries are of interest to IMSSS staff members because of our long interest in the teaching of mathematics, as well as our present concern with teaching mathematics by radio. We were able to acquire primary mathematics textbooks (sometimes more than one version) from many of the countries we visited. We plan, as time permits, to survey these texts to obtain information relating to three questions: (a) how great is the commonality among mathematics curriculums around the world (as exemplified by our sample of texts)? (b) how have individual countries modified curriculums to satisfy their unique needs and circumstances? and (c) to what extent has 'modern math' been incorporated into the primary mathematics programs in developing countries?

In order to collect evidence relating to the commonality of mathematics curriculums we will survey texts to see what topics are taught at each grade level, in what order they are introduced, and what instructional strategies are used. For comparison, several modern texts from the United States will be included in the survey. We will then ask whether the differences between texts can be attributed to country differences, how illustrative materials differ, and to what extent examples and word problems differ in content and context.

Characterizing the amount of modern mathematics in the texts is somewhat more complicated. There appear to be no empirical studies of texts or curriculums that define a measure of 'modernity'; we will work towards this goal by undertaking a content analysis of a typical modern American text series (or perhaps more than one) and a typical

traditional American text series (one published before 1955 and widely used in schools). A comparison of these text series should enable us to identify items and instructional strategies as 'modern' or 'traditional'; their presence in other texts will permit a characterization of the degree to which the text is 'modern'.

The list of foreign and American texts that will be included in the survey is presented in Table 14. (Some information about the text from Vietnam is missing; through an oversight this information was not translated). We have also obtained texts from Nepal and will include these if we can have them translated.

The size of the texts varies from 32 pages (Swaziland) to 288 pages (United States), but there is a large measure of agreement in content. Table 15 shows the percentage of text pages devoted to each topic presented. Although 20 topics are represented among the texts, the bulk of the instructional material falls into four categories. These are

1. basic concepts: relations, such as larger-smaller, tall-short, many-few,
2. number concepts: work with sets, counting, writing numerals, place value, ordinal numbers,
3. addition: basic facts, algorithms,
4. subtraction: basic facts, algorithms.

Figure 1 shows the proportion of each text covering these four topics (including pages that treat addition and subtraction together as inverse operations). For all but one text, at least two-thirds of the pages are allocated to these topics. Among other topics that occur in almost all texts are equalities and inequalities, measurement, money, and telling time. Only rarely does one of these occupy more than 10

TABLE 14

First Grade Mathematics Textbooks

Text Survey

Country (Abbr.)	Publication date	Title, Author, Publisher Information
Brazil (B1)	1973	A nova matematica Published privately by Bloch Editores 130 pages
Brazil (B2)	1973	Vamos aprender Matematica Adaptation of the 1965 Scott, Foresman and Co. text. Published by the Ministry of Education 152 pages
Ecuador (E)	1970	A jugar con los numeros. Published by the Ministry of Education (development of texts supported by USAID) 216 pages
Indonesia (I)	1972	Matematika 1/a; matematika 1/b Published by Ministry of Education (Revision of Entebbe texts) 144 pages
Nicaragua (NC1)	1968	Matematica Primero, Second Edition Editor: Oscar Velasquez Published by Ministry of Public Education (Written under auspices of ROCAP) 87 pages
Nicaragua (NC2)	1972	Hagamos matematica en Nicaragua Adaptation for Nicaragua by Vitalia Rojas Flores Publisher unknown (private company) (Adaptation of Colombian text) 172 pages
Nigeria (NG1)	1972	Oxford Modern Mathematics for Nigerian Primary Schools. Prepared under the direction of an African Editorial Board. Published privately by Oxford University Press 64 pages
Nigeria (NG2)	1973	Oxford Arithmetic Course, Nigeria, Third Edition Prepared under the direction of an African Editorial Board. Published privately by Oxford University Press. 64 pages
Peru (P)	1973	Matematica 1; fichas de trabajo. Experimental edition, prepared and published by the Ministry of Education. (Undergoing pilot testing) 129 pages

TABLE 14 (continued)

Swaziland (S)	1968	First steps, sets, and shapes. Longman's Primary Mathematics. Published privately by Longman (Capetown) 32 pages
Thailand (T)	1972	Arithmetic 1. Seventeenth Edition. Published privately. Follows Ministry of Education guidelines. 80 pages
United States (US1)	1968	Elementary School Mathematics, second edition. Robert Eicholz. Published privately by Addison-Wesley. 288 pages
United States (US2)	1972	The Random House Mathematics Program. P. Suppes, G. Phillips, R. Carr, J. Kaplan Published privately by Random House. 288 pages
Vietnam (V)	1969	? 142 pages

TABLE 15

Allocation of Pages among Topics in First Grade Texts

Percentage of pages

Topic	Text *													
	B1	B2	E	I	NC1	NC2	NG1	NG2	P	S	T	US1	US2	V
Basic concepts	14	1	7	1	6	3	9	3	19	9	12	0	3	2
Number concepts	32	33	37	32	43	30	33	27	33	31	13	31	27	20
Addition	15	14	16	39	7	29	20	20	16	33	11	26	19	23
Subtraction	4	14	12	15	6	13	12	17	0	5	11	14	14	20
+ and - as inverse operations	1	6	3	0	12	5	1	0	0	9	1	5	8	1
Multiplication readiness	4	0	2	0	3	0	0	6	1	0	3	1	2	0
Multiplication	0	0	2	0	1	0	0	3	0	0	1	0	0	0
Division readiness	4	0	1	0	2	0	0	0	2	0	0	0	0	0
Division	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Fractions	0	0	3	1	5	0	2	3	0	0	0	1	2	0
Equality and inequality	2	3	3	5	2	4	0	0	12	6	0	5	4	0
Laws of arithmetic	1	2	2	1	0	2	0	0	0	3	0	5	2	1
Measurement	2	6	3	0	6	5	5	3	0	0	3	2	3	4
Money	7	5	2	0	0	2	3	3	0	0	7	6	3	7
Time	2	1	1	2	3	1	2	2	0	0	9	1	2	0
Calendar	2	1	0	0	0	1	0	0	0	0	6	0	0	0
Geometry	5	3	3	4	0	1	5	0	16	3	0	0	5	8
Graphs	0	0	0	0	0	0	0	0	2	0	0	0	2	0
Word problems	2	3	1	0	2	4	0	0	0	0	11	0	0	1
Reasoning	0	0	0	0	0	0	0	0	0	0	0	2	2	0
End of book review	6	0	0	0	0	0	9	13	0	0	14	1	2	13

* Abbreviations refer to texts listed in Table 14.

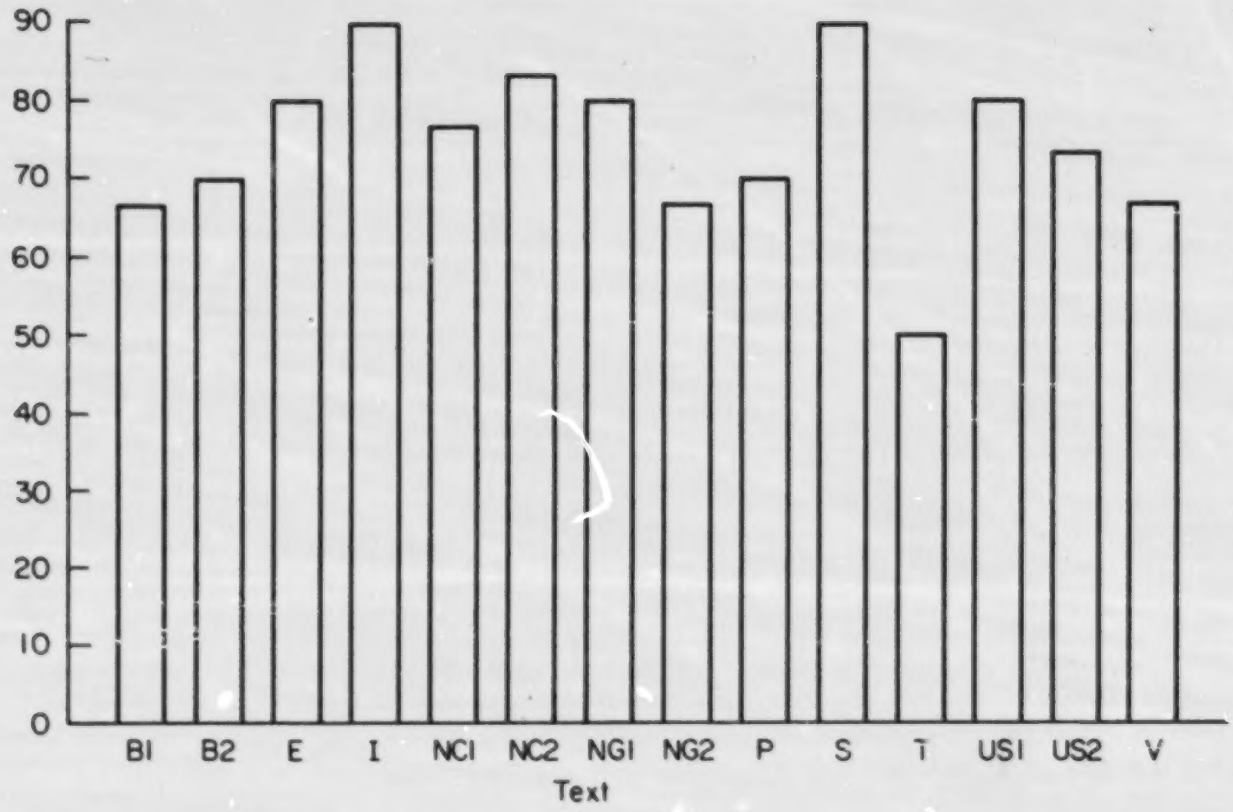

Figure 1. Percentage of textbooks allocated to four basic topics. Textbook abbreviations refer to the list presented in Table 14.

percent of the book. Multiplication readiness, fractions, laws of arithmetic, geometry, and word problems occur somewhat less frequently, and the remainder of the topics occur in fewer than half of the books.

Within the topics covered by all texts there are differences in the scope of the material and in the instructional strategies employed. Further characterization of the texts along these lines, as well as assessment of the extent to which modern mathematics is incorporated, will be made.

Contact with Other Projects and Collection of Material

During the year the project staff has tried in several ways to build contacts with other groups using radio and other media for educational purposes, and to increase our familiarity with educational projects in the developing world.

Radio and TV projects. We wrote to Mr. Andre Hagon of the Permanent Education Service in Brussels for information about their TV series, "New Mathematics: Primary Education," which received a Japan Prize award in 1972, and received scripts and other useful descriptive materials.

We were able to obtain a tape (in Polish) and script (in English) from the radio series, "One, Two, Three...And What Then," from Dr. S. Mikulicz of Polskie Radio, Warsaw. This series also won a 1972 Japan Prize. This series is broadcast once a month, and is designed to be motivational in character. A few mathematical problems are built into a rich story setting.

We obtained a sample tape and a set of scripts for the radio series, "Reckoning with Boris," produced by the Wisconsin School of the Air. Like the Polish series, these programs are designed to supplement classroom instruction. The programs were written for third graders but are probably suitable for older primary students as well.

The Wisconsin Research and Development Center for Cognitive Learning during the period from the late 1960's to early 1970's developed a television course, "Patterns in Arithmetic," designed to be complete in itself, i.e., no materials beyond the videotapes, pupil exercise books, and a teacher's manual would be required. That program is currently in use, but not exactly as intended, by the Archdiocese

of San Francisco in some of its primary schools. We were able to view several programs at the ETV Center at St. Patricks Seminary, and then to watch classes taking TV lessons at Saint Albert the Great Elementary School in Palo Alto. The teachers tended to use the programs as a supplement to their regular classroom instruction, rather than following the teacher's manual. They are free to use the programs or not, as they choose, and can request rebroadcasts from the ETV Center.

INNOTECH. During the visit to Southeast Asia in September, 1973, the Stanford team visited with members of INNOTECH, the regional center for Educational Innovation and Technology established by the Southeast Asian Ministers of Education Organization (SEAMEO) and located in Saigon. We have remained in touch with them, and the Radio Mathematics Project was described in the INNOTECH newsletter last fall.

Library of materials at Stanford. We have obtained during the year many materials related to media projects and education in the developing world. These have been catalogued, and a computer program has been written to allow us to access this material. Although the amount of this material is small, the organization of search procedures now will allow us to add to the collection and maintain its usefulness.

Library of materials in Nicaragua. We learned during visits to Nicaragua that there are few reference materials available to those who are charged with curriculum development and research activities. We are building a small library of journals, standard textbooks, and reference material for the use of project staff in Nicaragua. We have made no attempt to provide comprehensive coverage, but rather, have restricted the materials purchased to those considered useful by the Stanford staff. The materials purchased to date are in English. Another set of works, in Spanish, will be ordered from RTAC through the AID Mission in Managua.

SUMMARY

The objectives for the 1973-1974 project year are listed on page 2 of this report. Here we summarize briefly the progress made towards reaching each of these objectives.

1. Site selection. We have, together with AID, selected a primary site for the project; that process was described in Searle (1974) and in this document. Preliminary discussions have been held concerning the selection of a secondary site, and tentative agreement has been reached to choose that site outside of Latin America. No further plans have yet been made for implementing the project in a second site.

2. Working relationships. Staff activities towards establishing working relationships with appropriate Nicaraguan government and education officials have been described in this report. Approximately nine months were spent in selecting a country, and another two months were needed to provide language training and orientation for Stanford staff members, and to relocate them in Nicaragua. During June, staff members turned their full attention to establishing a working project in Nicaragua.

3. Research design. Because so much of the project year was spent in site selection and negotiations, the staff was unable to work with Nicaraguans in developing a more detailed research design. Rather than put off that activity we prepared a preliminary document (Searle, Friend, Jamison, Suppes, Tilson, & Zanotti, 1974) that will serve as a guide for the research, but will remain open to modification as a result of interaction with Nicaraguans.

4. Curriculum outline. The staff found that the Nicaraguan Ministry of Public Education has within the last several years revised the mathematics curriculum and has prepared a detailed curriculum guide for the first six grades. We have agreed with Nicaraguan officials that the project will use their curriculum guides in developing radio lessons. Therefore, the project has not undertaken to develop an independent curriculum outline.

5. Pilot testing. A preliminary description of pilot testing of radio scripts is contained in this report, and a more detailed report is forthcoming.

6. Project manager. Mrs. Jamesine Friend, a mathematics curriculum specialist with extensive administrative experience, was hired as project manager on February 1, 1974. She has participated in site selection and all aspects of planning the research and operational aspects of the project. She moved to Nicaragua in June, 1974.

7. Review Committee. AID established a Research Review Board that met in Washington, D.C. on June 21, 1974 with Stanford and AID personnel. The meeting was devoted to a discussion of research plans for the project.

8. Linkages. Preliminary attempts to make contact with other media projects and with regional organizations are described in this report.

At the close of the first year of funding, we are in the process of establishing a working project in Nicaragua. We look forward to the next project year, as we become fully operational.

REFERENCES

Searle, B. Site selection process: Radio Mathematics Project. Stanford, Calif.: Stanford University, Institute for Mathematical Studies in the Social Sciences, 1974.

Searle, B., Friend, J., Jamison, D., Suppes, P., Tilson, T., & Zanotti, M., Research plan: Radio Mathematics Project. Stanford, Calif.: Stanford University, Institute for Mathematical Studies in the Social Sciences, 1974.

APPENDIX A

Notes on What To Look for When Visiting a Potential Host Country

I. Purpose of primary education

What do different people conceive as the basic goals of primary education? E.g., preparation for secondary school, for school leavers who will be living in rural areas, etc.

II. Education Organizational Structure

A. What Ministries, divisions therein, or other organizations are involved with the following:
   1. primary schools.
   2. teacher education programs
      a. preservice
      b. in-service.
   3. inspectorate.
   4. educational broadcasts.

B. To what extent and in what ways are these various divisions related?

C. Who makes policy decisions and develops curriculum in mathematics at the different levels?

III. Finance

A. What is the over-all cost of education per annum:
   1. capital expenditure?
   2. recurrent expenditure?

B. How much of the total goes for:
   1. primary education
   2. teacher education
   3. educational broadcasts

C. What is the cost of primary education per child per annum?

D. What are the sources of funds for curriculum development, special teacher training, and educational broadcasts?

E. What is the estimated expenditure per child on
   1. fees?
   2. books?
   3. other?

IV. Language

A. What languages are used as media of instruction?

B. At what grade level is each used?

C. What languages are taught in the primary school?

V. Schooling

A. Who goes
   1. Is education compulsory? up to what age or class?
   2. What percent of school age children attend school at each grade level?

B. Promotion-retention
   1. How are such decisions made?
   2. What percent of children are retained at each grade level?
   3. What is the average length of schooling to produce an elementary level graduate?

C. Selection
   1. Do final year students of the primary school write an examination
      a. for a leaving certificate?
      b. for selection into higher institutions?
   2. What is the nature of this examination?
   3. What other criteria is used for selection?
   4. How important is the mathematics part of this examination?
   5. Who writes the mathematics part of this examination?

D. Prospects after primary school
   1. What advantages accrue to students with various levels of education?
   2. How many and what kinds of jobs are available?
   3. Where are the available jobs?
   4. To what extent is the mathematics program designed to take into account the above information?

V. School characteristics.

A. General
   1. What are the school hours and daily schedules? How well are they adhered to?
   2. What are the attendance patterns? reasons for continually or periodically low attendance?
   3. How many classrooms and schools are there?
   4. What is the school population by grade?
   5. What is the range and average size of the classes? schools?
   6. How many and what kinds of administrators and other non-teaching personnel are there? What do they do?
   7. What is the size and demographic characteristics of the different areas from which different clusters of schools would draw its population?

B. What teachers do

1. What is the structure of the class-day? length of the periods? recesses? lunch period?
2. What teaching methods are used?
3. What kinds of interaction is there between the teacher and children?
4. What kinds of materials are used during the the lessons?
5. Are there written assignments? homework?
6. What kinds of tests are used? How are they prepared and graded?
7. How much does the teacher rely on the official syllabus?

C. What the students do

1. What kind of pupil-pupil interactions are there?
2. Is there any small group work or individualized study?
3. What kinds of responses are the students called upon to make?
   a. oral - unison? individual?
   b. written - paper? blackboard? slate?

D. Resources

1. What kind of materials does the teacher have?
   a. teacher's guides or syllabuses
   b. other resources books
   c. visual aids
   d. library facilities
   e. other materials
2. What do the children have?
   a. textbooks
   b. other books, e.g.. library
   c. paper, pencils, notebooks

VI. Teachers

A. Where do the teachers come from? local? expatriate?
B. What general education are the teachers required to have?
C. What professional training is required?
D. What are the different grades of teachers? What percentage of teachers fall in each grade?
E. Are there plans for greatly expanding the total number of teachers or changing the quality as reflected in the different categories above?
F. What is the rate of teacher turnover?

VII. Teacher education

A. General

1. What is the organizational structure for teacher training?

2. How many colleges of education are there? Are the universities involved?

3. What is the relationship between the teacher education programs and the various divisions in the Ministry?

4. What grades of teachers are produced at the various teacher education institutions?

5. Is there a national syllabus? How much variation is there from college to college and subject to subject?

6. From where does the syllabus originate?

B. Preservice

1. What are the nationalities of the staff?

2. What is the student-tutor ratio?

3. What is the number of math tutors compared with those in other subject areas?

4. What is the total time students attend the teacher training program?

5. What percent of the time spent on the academic areas is devoted to math education? How much total time is this?

6. How is this time divided up between

a. academic study of math?

b. specific study of new math?

c. methods of teaching?

d. supervised teaching?

C. In-service

1. What kind of in-service training exists?

2. Who is responsible for this?

3. In what different ways is this carried out? short courses? longer (one year) up-grading programs?

4. Where are the courses held?

5. What is the criteria for selecting teachers for these programs?

6. How is it determined what special courses are needed?

7. Have there been any courses or are any planned for the near future which relate to

a. new math education?

b. instructional broadcasts?

D. In what ways would the government provide support for the teacher training programs needed for the math-radio project?

1. released time for existing teachers, tutors, inspectors, etc.?

2. full-time college tutor?

3. materials?

4. facilities for conducting workshops?

5. transportation costs for participants?

6. per diem and/or other expenses?

IX. Mathematics syllabus

A. Is there a national syllabus?
B. What text books are recommended?
C. What content of mathematics is taught at each grade?
D. What pedagogical approaches are recommended?
E. To what extent do teachers rigidly follow the syllabus in terms of the
    1. content covered?
    2. pedagogical approaches recommended?
F. Is the syllabus reviewed periodically? How often? By whom?
G. Are there any national or local teachers' organizations devoted to math education?

X. History of efforts to change schools

A. What educational reforms have been attempted in primary schools or colleges of education?
B. What have been the results? Reasons?

XI. Educational broadcasting

A. General
    1. How long has educational broadcasting been in existence?
    2. Are the broadcasts designed for formal or informal education?
    3. What subjects have been taught?
    4. At what age level have the broadcasts been aimed?
    5. What have been the purposes of the broadcasts?
        a. core instructional material?
        b. supplementary or enrichment?
    6. What is the intended relationship of the broadcasts to the teacher? supplementary materials?
    7. What kind of special training do teachers receive?

B. Facilities
    1. How modern and reliable is the broadcast equipment?
    2. What percent of the programs are unable to be broadcast according to previously set schedules? Reasons?
    3. What is the power and range of the transmitters?
    4. How adequate are the studio facilities?
    5. What percentage of schools or classrooms have operating radio receivers within the range of the transmitters?
    6. What is the actual operating procedure for a school when its radio breaks down in order to get

C. Personnel

1. Of what nationalities are the production and broadcast personnel?
2. What is their level of experience?
3. Is the number of staff adequate for what they are already trying to do?
4. Will the present staff be able to handle the additional load of a new mathematics program?

Do they have the personnel to do the following functions?

a. a person to oversee all aspects of production
b. sound recording, addition of music and sound effects, sound editing, sound mixing
c. professional narrator
d. someone experienced in writing radio scripts for children

XII. Printing

A. What printing facilities would be available for the project?
B. What is the quality of their work? graphics? photo reproduction?
C. What would be a conservative estimate of time needed for having a set of materials prepared, printed, bound and delivered?

XIII. School locations and transportation

A. How many schools are within a
1. one hours drive from the studio?
2. two hours drive from the studio?
B. What percent of the schools and/or children within these distances are urban or rural?
C. Are the schools clustered in a way which would make it possible to establish one school within each cluster as a local center for frequent teachers' meetings?
D. Are the roads to these schools open the year round?
E. Is local transportation readily available for teachers to travel to
1. nearby training centers in a school?
2. other training centers such as colleges of education?
3. the studio facilities?
F. Do the schools have
1. electricity?
2. telephones?

XIV.Computer facilities

A. What computer facilities are available?
B. How much of the data analysis can be handled there?
C. Can any of the computer curriculum work be done there?
D. Are the personnel sufficiently skilled to handle the required work? with a minimum of additional training?
E. Will these people have the time to work on this project?

XV. Urban-rural comparison

How are the urban and rural schools different in relation to the following characteristics:

1. length of stay in school
2. school facilities
3. achievement levels
4. proportion who continue with further education
5. differences in curriculum
6. differences in SES
7. quality of teachers
8. books, paper, other materials
9. size of classes
10. absenteeism

XVI.Host country support

A. office and storage space
B. use of broadcast facilities
C. facilities for teacher training workshops, including over night accommodations for participants
D. full or part-time personnel
    1. high level assistant to project manager
    2. curriculum specialists
    3. computer programmers
    4. field assistants
    5. broadcast personnel
    6. teacher training tutor
E. released time
    1. participating teachers
    2. head teachers
    3. inspectors
    4. other administrators
    5. teacher training tutors
    6. broadcast personnel
F. support from math education groups relating to
    1. policy
    2. curriculum development
    3. national exams
G. printing facilities
H. expatriate housing
I. vehicles for project related work

APPENDIX B

Correspondence Regarding Choice of Nicaragua as Project Site

February 15, 1974

Ing. Jose A. Mora R.
Ministerio de Educacion Publica
Managua, Nicaragua

Dear Mr. Minister:

The staff of the Stanford radio mathematics project and A.I.D. officials in Washington have evaluated the twelve prospective sites for the project. We view most favorably the prospect of locating the project in Nicaragua. We feel that the previous work on the development of mathematics texts and curriculum guides would serve as a strong foundation for the development of radio-based instruction. In addition, we were impressed by the enthusiastic response of Ministry personnel and the educators we met in the Department of Masaya.

However, before reaching a final decision, we need further information about the availability of several of the components necessary for implementation of the project. Chief among these is the availability of trained personnel to serve as staff members. We expect, when we become fully operational, to need a local staff of from eight to twelve people. Three or four of these should be people who have had some experience working with primary school mathematics curriculum, writing texts or guides, or other related activities. In conjunction with the Stanford staff, they will write radio scripts for the mathematics lessons, prepare teacher's guides, and, later on, help run teachers' workshops. We will also need several field personnel whose primary responsibility will be to travel to local schools and collect students' papers, talk to teachers about the project, and in general maintain the liaison between the project staff and the schools. The project will need one or two people who can be trained as key punch operators, and some people whose skills we can use on a part-time basis, for example, a graphics artist and a computer programmer.

As we did not have the opportunity to explore these needs in detail during our brief visit to Nicaragua, we would like to return to discuss these issues and any questions that you may have concerning the location of the project in Nicaragua. If we agree that locating the project in Nicaragua is feasible, then we would like to start making arrangements for obtaining office space, use of a radio station, cooperation of schools, and so forth. We are eager to make a final decision about country selection, and begin operations in early May. Thus, we would like to make our visit quite soon, the first week of March if possible. Mrs. Jamesine Friend, who will be Project Director, and Mr. Tom Tilson, who will work with her, will accompany me.

We would also like to discuss with you the possibility of inviting a participant from some other Central American countries to work with the project staff in Nicaragua. We feel that we can increase the impact of the project on a regional basis if we can, from the beginning, involve representatives from other countries, and we are interested in exploring the feasibility of such a scheme with you.

We look forward to hearing from you, confirming your continued interest in the project, and suggesting specific dates for our return visit to Managua.

Sincerely yours,

Barbara Searle, Ph.D.
Project Coordinator

cc: Peter Tobia, USAID/Nicaragua
David Sprague, USAID/Washington
Patrick Suppes, Director, Institute for Mathematical Studies in the Social Sciences

BWS:sf

APPENDIX C

Matters Settled During Negotiation Period

This is a list of questions which were negotiated during the period of March 7-15, 1974.

I. Relations with educational bureaucracy

II. Project location--proposed site

III. Widescale implementation

IV. Project personnel

V. Office facilities and equipment

VI. Air time and recording time

VII. Availability of computer facilities

VIII. Teacher training facilities

IX. Printing facilities

X. Role of the AID Mission

XI. Role of AID Washington

I. Relations with educational bureaucracy

A. Exactly where does the project fit in the bureaucracy --primary linkage--other linkages

The project will eventually fall administratively under the jurisdiction of the Departamento de Investigacion y Evaluacion Educativa, a newly-established research unit within the Oficina de Planeamiento Integral of the Ministerio de Educacion Publica (MEP). For the present, the Director General de la Oficina de Planeamiento Integral, Prof. Raul Quintanilla, is exercising administrative responsibility.

I. Relations with educational bureaucracy, continued

B. What is the administrative relationship between MEP and the Inspectorate of the Department of Masaya?

The Inspectorate reports directly to the MEP. Prof. Guillermo Escobar, Inspector Departmental de Masaya, has authority to permit use of schools for testing and experimental purposes, call teacher's meetings, request cooperation of teachers, and so on. He has agreed to assist the project staff in these ways.

C. Is there a research organization with which to establish linkage? If so, how will this linkage be established?

The Departamento de Investigacion y Evaluacion Educativa within MEP, headed by Juan Alamo Briggilier, was organized within the last two months. Senor Alamo conferred with project staff during the negotiation visit, and agreed to work closely with the project.

D. What kind of University connections can be established?

The answer is not clear at this time. The National University does not at present either train primary teachers nor conduct research in primary school education.

E. Where is the nearest Teacher Training school? With whom can we make contact? What kind of cooperation is possible?

There are two Normal Schools near Masaya. A school for girls is located at San Marcos and a school for boys at Jinotepe. The team did not visit either of these. Mrs. Vrooman knows people at these schools and can establish contact with them.

F. What arrangements can be made for regional cooperation? What organizations should be involved? How should contact be made with them--by host country? Stanford staff? AID?

The Minister of Education agreed to take the initiative in soliciting the participation of other Central American countries and Panama. He suggested that he mention the project at a forthcoming meeting of Central American Ministers of Education (to be held at the end of March or the beginning of April) and follow up the first mention next fall with letters inviting each government to send a representative to learn about and perhaps work on the project.

II. Project location -- Proposed site

A. What is urban area in which project staff will be located?

The project offices will be located in the town of Masaya, approximately twenty-five miles from Managua.

B. How large a surrounding rural area is needed to find

1. 1500-2000 students in first grade?
(Is this a reasonable number?)

According to preliminary data supplied by the Inspectorate de Masaya, there are about 97 first-grade classes in the Department, with an average of 30 to 40 students per classroom. Thus, there are probably more than 3000 first-graders. Approximately two-thirds of of the schools are rural, but probably fewer than two-thirds of the students are rural, since rural schools tend to be smaller. We did not obtain an estimate of the number of rural and urban students. Data for 1971, published by the Ministry of Education, are in disagreement with the figures provided by the Inspectorate; they indicate that in 1971 there were 3,477 urban and 2,991 rural first-grade students in Masaya.

2. 1500-2000 students in last year of primary school?
(Again, reasonable?)

According to preliminary figures, there are approximately 39 sixth-grade classrooms, with perhaps 1,100 students. (The 1971 figure, from the same source quoted above, is 1,341.) If the project prepares materials for sixth grade, it will probably have to use classrooms in adjoining departments.

3. If the area required is larger than a single department how are administrative arrangements to be handled?

The Minister of Education must request cooperation of each Departmental Inspector involved, and work would be coordinated centrally, rather than by cooperation between departments.

II. Project location, continued

C. What is the character of the proposed rural area? Is it representative of the country's rural population in the following characteristics?

(Data used here are for 1971, unless otherwise noted.)

1. Percentage of rural children in school
   Country: 68%
   Masaya: 83%

2. Quality of teachers--percentage of certified teachers
   Country: 79%
   Masaya: 94%

3. Size of schools- percentage of classrooms with one grade, two grades, more than two grades

	1 grade	2 grades	>2 grades
Country:	79	5	16
Masaya:	84	5	11

4. Pupil-teacher ratio--Number of pupils per teacher
   Country: 38
   Masaya: 35

5. Distribution of students across grades--proportion of children in each grade

	Pre	1	2	3	4	5	6
Country:	2.7	36.6	19.0	14.9	11.5	8.6	6.7
Masaya:	.8	36.7	19.2	15.0	11.2	9.5	7.6

6. Dropout rate
   not known yet

7. Failure rate
   not known yet

8. Adult occupations
   not known yet

9. Adult (>10) literacy rate--percentage illiterate (1970)

	Urban	Rural
Country:	16.6	62.5
Masaya:	21.1	57.0

II. Project location, continued

D. School questions

1. What is the school calendar (start, vacations, end)

School starts close to February 15th, lasts through November. (Holidays?). The morning shift is from 8 a.m. to 1 p.m. Afternoon shift lasts from 2 to 6 p.m.

2. Is the school district(s) willing to allow the use of schools for experimental purposes?

Yes.

3. Are the authorities accepting of the need to test students? How do we obtain teacher acceptance for this?

Yes. The Inspector of Masaya suggested that he would hold a meeting of all the teachers involved, explaining the project, the type of cooperation needed, and making clear that tests were not to be used for the purpose of evaluating teachers, but only for evaluating the radio lessons. The Inspector would request that teachers cooperate with project staff in all aspects of the experiment.

4. Are there classrooms immediately available for pilot testing materials? Will the experimental population be large enough with these excluded? If not, can pilot testing be done in a neighboring district?

Classes are available for pilot testing. During discussions about experimental design, the staff decided to include classes used for pilot testing as experimental classes. We learned that children are not assigned to morning or afternoon session in any systematic way. The staff will therefore investigate the possibility of using afternoon session classes as controls. In addition, some controls may be selected from a neighboring district.

5. Can the use of one-room schools be avoided (i.e. will the experimental population be large enough without them)?

Of the more than 100 schools in the Department, only 17 have only one room. In 1971, of 17,615 students in the department, 14,888 were in classrooms that contained a single grade.

6. What tests (if any) are used? Are results available? Can we obtain samples of classroom tests? See samples of student work?

There are no district-wide tests. A few sample tests were obtained. More will be available when the project gets underway.

II. Project location, continued

7. What kinds of data about children are available from schools, e.g. age, family situation, school history, etc?

Not known at this time.

8. Is there already an existing delivery system operating between school district headquarters and schools?

Departmental sub-inspectors visit schools every several weeks. No formal delivery system operates.

E. Where is each of the following located? How far is this from the project site?

1. Office building for project

Office space has been made available to the project at the local Instituto (high school), located in downtown Masaya several blocks from the Department Office.

2. Radio station

Radio Masaya is located in downtown Masaya.

3. Recording studio

There is currently a small recording studio at Radio Masaya that is barely adequate. The station is in the process of building a new recording studio which is scheduled to be completed in April. The studio will be available for project use, although details of scheduling were not discussed. Recording facilities at Radio Nacional will be available within 6 - 12 months.

4. Supervisor and other administrators of primary schools

Departmental offices are in Masaya. Some school supervisors live in the rural areas, near schools.

5. Teacher training school

These are in San Marcos and Jinotepe, both within 15 miles of Masaya.

6. Key punch

The project will rent a key punch for the project office.

7. Computer facility

The project will use the IBM 1130 at the Central American University, located in Managua.

II. Project location, continued

8. Printing facilities

There is a printing firm in Masaya, which was not investigated. The Ministry will within a year have new printing facilities that will be available to the project (if we buy paper and ink and pay any overtime that is necessary). There are currently (we understand) limited facilities (mimeograph and offset) available through the Ministry.

9. Garage for repair of vehicles

Probably in Masaya

10. Radio repair services

Not known yet

11. Post office

In Masaya.

F. Where will northamerican project staff live?

1. What kind of housing is available?

Houses are available. Finding one in a suitable location for a reasonable price may be very difficult.

2. What is the procedure for obtaining housing? How long does it customarily take? What kind of temporary facilities are available?

Both Friend and Tilson obtained temporary housing for June. Obtaining a house may take from 3 to 6 weeks. There are local real estate agents, perhaps some help through an Embassy newspaper.

3. Where are the nearest schools for northamerican children?
primary
secondary

The American School, the only English-language school in the area, is located in Managua. Registration opens June 1. All the project children may attend.

G. How will transportation needs of northamerican staff be satisfied? Will project vehicles be available for their use after working hours?

Yes. In addition, they will need to bring private cars.

III. Widescale implementation

A. If program is successful and economically feasible is the country willing to undertake widescale implementation?

This was not specifically discussed.

B. On what time scale is such implementation envisioned?

IV. Project personnel

The functions that project staff must carry out can be organized in the following six categories: administration, curriculum development, production of radio programs, research and evaluation, teacher training and school liaison, and support activities. Personnel needs will be described by category, with the understanding that some staff members may have responsibilities that fall in more than one category. (For example, a radio performer might also write curriculum, or a teacher trainer might also maintain liaison with schools.) The northamericans on the staff (three are currently contemplated) will fulfill some of the functions described. An estimated full staff strength (expressed as full-time equivalents--f.t.e--is given for each category. Not all functions must be staffed at full strength from the outset of project implementation.

A. Job categories

1. Administration (estimated 1 f.t.e.)

The Project Director handles administrative affairs of the project, maintains contact with the Ministry of Education, with the Stanford staff and with AID. Where appropriate the Project Director will delegate responsibilities to an Administrative Assistant. The Project Director will supervise all team leaders.

Jamesine Friend will serve as Project Director. Vitalia Vrooman will be Assistant Project Director, serving as the Administrative Assistant described above.

2. Curriculum development team (estimated 3 f.t.e)

Curriculum developers plan radio lessons and associated off-line material, write radio scripts, and prepare teachers' guides. At least one member of the team should have experience in the development of primary mathematics curriculum; at least one member of the team should have experience writing radio scripts for children. The team should include an expert in primary mathematics from the Ministry of Education. A person with artistic skills should be included on the team. This person will prepare illustrations for lesson materials and teachers's guides and should have drafting experience or training and some ability with free-hand sketching (cartoon style).

IV. Project personnel, continued

The team leader will coordinate the preparation of lesson-associated materials, the production of printed materials, and provide training for team members when necessary.

The curriculum development team will consist of Jamesine Friend, Vitalia Vrooman, David Cardoza, Ligia Roman, and a script writer (to be appointed). Jamesine Friend will be team leader. Art work will be done by artist in the Ministry audio-visual department.

3. Radio broadcast production team (estimated 2 f.t.e.)

The radio production team will produce, tape, and edit radio lessons, using scripts prepared by the curriculum development team. The team will produce sound effects, edit tapes, mix sound tracks, narrate, and so on. They will catalogue and store broadcast materials, and, in cooperation with the local radio station, will broadcast programs according to schedules worked out together with the curriculum development team and the Project Director. Team members will provide technical assistance to script writers to improve the quality of radio scripts. At least one member of the team should have experience editing radio tapes. At least one member of the team should have experience producing radio broadcasts.

The team leader will act as producer-director, supervising all aspects of broadcast production (in close cooperation with the curriculum development team leader), and will maintain contact with the local radio station. The leader will train team members when necessary.

The members of this team have not yet been identified.

4. Research and evaluation (estimated 3 f.t.e.)

The research team will develop and implement the research and evaluation design, plan and execute additional experiments, collect required data, conduct interviews and surveys, and observe and record classroom activities. One member of the team will write computer programs to collect and summarize data. At least one member of the team should have experience designing and carrying on educational research. Field personnel on this team will also carry out teacher training activities.

The team leader will supervise all research activities and train team members.

Tom Tilson will serve as team leader. Three teachers, provided by the Ministry to work on the project, will serve on this team and the teacher training team. Computer programming will probably be done by the staff of the Computer Center of the Central American University.

IV. Project personnel, continued

5. Teacher training team (estimated 3 f.t.e)

The teacher training team will prepare and conduct teachers's workshops and other teacher training activities (including special radio broadcasts) on a schedule determined by the Project Director, the curriculum development team leader and the teacher training team leader. Field personnel (from this team and the research and evaluation team) will also maintain contact with schools participating in the experiment. Team members will travel to schools to deliver materials, pick up data, confer with administrators and teachers and arrange for radio repairs. They will provide feedback to project staff members about the functioning of radio lessons in the classroom. All members of the team should have primary school teaching experience and at least one member should have experience in providing in-service training for primary school teachers, preferably in mathematics.

The team leader will supervise all teacher-training activities, organize schedules for visiting schools and train team members.

Tom Tilson will serve as team leader. The teachers mentioned above will also serve on this team.

6. Support team (estimated 3 1/2 f.t.e.)

The support team will provide secretarial assistance for all other teams, maintain inventories of project materials and take charge of their storage and dissemination, run errands and drive project cars when necessary, key punch data, translate materials prepared by the staff from English to Spanish or Spanish to English, and so on. The team will need at least one typist and one key punch operator. At least one person must be able to drive.

The Project Director will serve as team leader for the support team.

The initial team will consist of a secretary and a driver who will be able to run errands. A key punch operator will be added several months after initiation of work. The individuals who will serve in these positions have not yet been identified.

IV. Project personnel, continued

B. How are personnel to be recruited?

1. What is the local recruitment procedure?
How long does it take to fill an opening?
How large is the pool of candidates for each job?
What other programs are recruiting from the same potential pool?

At least eight Nicaraguan staff members are already employed by the Ministry of Education and need only be transferred from their current position to the project. Vrooman, Cardoza, and Roman have already been directed to work half-time on the project, and will become full-time as of June 1, when northamerican staff are expected to arrive in Nicaragua. Others will be transferred as needed. The Ministry of Education has accepted responsibility for recruiting other staff members as needed. There do not appear to be other projects competing for staff members.

2. Will personnel be recruited from the locale of the project? If not, what inducements will be needed to attract them?

Most staff members will live in Managua and will probably have to use public transportation to get to Masaya each day. At present no extra compensation for this is contemplated; however, the Project Director can alter this decision if need be.

3. Who has final responsibility for hiring and firing?
How are promotions and change of status within staff determined? What is the procedure for obtaining replacements?

The mechanism for transferring staff members who do not do satisfactory work was not discussed. The Ministry retains final authority over Nicaraguan staff members, since it is paying their salaries.

4. Who will pay salaries for each of the listed positions? Who has responsibility for salary scales? Who pays fringe benefits? What are they?

The Ministry is paying the salaries of all Nicaraguans currently on the staff.

V. Office facilities and equipment

Space requirements: Several offices, room for meetings, place for art work, desk for each full-time equivalent staff member.

A. Where will offices be located? Who will pay rent?

Project offices will be in the Instituto building in Masaya in two large rooms, with movable partitions provided to separate several individual offices. The library of the school will be used for large meetings. The space will be provided free of cost to the project. Presumably, although this was not made explicit, janitorial services will also be provided.

B. How is each of the following to be provided, by host government, by Mission, by project...if by project, purchased locally or in US? How many are needed?

1. Desks	Ministry (MEP)
2. Chairs	MEP
3. Tables	MEP
4. Duplicating machine (Mimeograph, Ditto, Xerox)	Stanford
5. Typewriters, typewriter tables	1 regular typewriter -- MEP 1 primary typewriter -- Stanford
6. File cabinets	MEP
7. Storage cabinets	MEP
8. Telephone	Stanford
9. Stationary supplies	Stanford
10. Vehicles, including gas and maintenance	Stanford
11. Tape for radio programs	Stanford
12. Tape recorders and tape	Stanford
13. Magnetic computer tape	Stanford
14. Punched cards	Stanford
15. Radio receivers	Stanford
16. Key punch machine	Stanford

VI. Air time and recording time

A. Which radio station will be available for use? What is its range? Are their any known reception problems, areas with especially poor reception?

The project will use Radio Masaya. A commitment has been made for use of air time, according to the time schedule presented below. Reception problems have not yet been investigated.

B. Is there a commitment for increasing amounts of air time during lifetime of project?

Need for air time during school hours:

First broadcast year (school year starting in 1975)	20-40 min/day
Second broadcast year	40-120 min/day
Third broadcast year	60-200 min/day

(Time estimates include possibility of teacher broadcasts and repetition and review programs)

C. Can project determine broadcast times or are they to be specified by radio station?

Don't know at this time.

D. How much time per week is available for use of recording studio? Who determines scheduling for studio use? How flexible are schedules? Which users have priority?

Don't know at this time.

VII. Availability of computer facilities

A. What is the financial arrangement for obtaining computer time?

The Minister said that he could obtain free computer time for us at the computer located at the Central American University (UCA). How much time would be free, and how much we would have to pay for, was not determined.

B. Will project supply programmer or will computer center? If project, how does programmer interact with computer? How much time is he/she allotted for programming and debugging?

The Computer Center at UCA will do the programming. Rainer Schulz, Systems Programmer on the Institute staff, will serve as consultant for the project.

VII. Availability of computer facilities, continued

C. What will be schedule of computer use? What priority does project work have?

Not known at this time.

D. What kinds of transportation or other arrangements are necessary to get data to computer?

Cards will have to be brought from Masaya to Managua, no less frequently than once a week, if possible more often.

VIII. Teacher training facilities

A. Are there on-going in-service teacher training programs? Can the project make use of these? If not, can we obtain help organizing our own teacher training services?

B. What are the costs associated with in-service teacher training?

IX. Printing facilities

A. What is the financial arrangement for obtaining printing? Is the printing facility government-operated or private?

B. What is turn-around time for printed material?

C. What priority does project have for use of facilities?

The project staff, subsequent to the visit, has decided to obtain the equipment to make electronic stencils and a duplicating machine that will allow reproduction of up to 10,000 copies from a single stencil. Having printing equipment located in the project offices will greatly facilitate the kinds of scheduling problems alluded to above.

X. Role of the AID Mission

A. What will be the relationship between the AID Mission and project staff?

Not clear at this time. Dr. Peter Tobia, head of Human Resources for the Mission, and a source of much help and expertise, may be leaving the Mission.

XI. Role of AID/Washington

A. How are decisions to be made?

We want to maximize the number of decisions that can be made on-site. For what types of decisions must the Washington AID office be consulted? Must such communications be routed through the campus staff?

APPENDIX D

Agreement Concluded Between the Agency for International Development and the Government of Nicaragua

I. INTRODUCTION

Pursuant to the General Agreement for Economic, Technical and Related Assistance, signed between the Government of Nicaragua and the United States of America on March 20, 1962, and in accordance with the Inter-American Program for Economic and Social Development established by the Act of Bogota and the Conference of Punta del Este and with the Declaration of Central America signed in San Jose, this Project Agreement is entered into between the Agency for International Development (AID), an agency of the Government of the United States of America, and the Government of Nicaragua, represented by the Ministry of Public Education.

II. PROJECT DESCRIPTION

The purpose of this project is to develop a system for designing, implementing and evaluating low cost radio-based instructional materials. A central feature of the system will be the use of rapid and specific reporting of student performance to materials developers, to provide for immediate and effective modification of these materials. The first application of this system will be in the development of a primary-level mathematics course to be used in Nicaragua. The system for developing instructional materials is expected to be applicable to other subject matters and to other countries. The mathematics curriculum materials developed during the course of the project will be usable, with minor modifications, in other countries.

III. OBJECTIVES

The objectives of the project are: 1) to demonstrate the feasibility of providing a course of instruction in primary mathematics using radio, 2) to evaluate the effectiveness and impact of the instructional program, 3) to determine the effectiveness in relation to costs, of various components of the instructional program, 4) to provide a model for other countries that wish to use radio for instructional purposes, and 5) to build within the Research, Evaluation and Education Technology section of the Ministry of Public Education, the capabilities for continuing educational experimental programs, using the knowledge, and skills gained as a result of this experiment.

IV. PROJECT IMPLEMENTATION PLAN

The implementing agent for this project funded by AID will be the Institute for Mathematical Studies in the Social Sciences of Stanford University, hereinafter referred to as Stanford. The Ministry of Public Education, hereinafter referred to as Ministry, in cooperating in this project will provide counterpart staff to the implementing agent for carrying out the objectives of this experimental project. Formation of the project staff is underway now and preliminary work will precede the arrival of two Stanford staff members on or about June 1, 1974. Upon arrival of the Stanford staff members in Nicaragua, they will be joined by three Ministry staff members. Since the Department of Masaya has been chosen as the site for this experimental project, a project office will be established in the Instituto de Masaya. Once the project office has been established, additional Ministry staff will be provided to work with the project, and perhaps Stanford will provide one additional staff member.

The initial work by the Stanford and Ministry staff will be to develop a detailed and specific research design for the project. Although this design will be a joint effort, Stanford will bear final responsibility for its successful completion. Production of materials will commence immediately, in preparation for pilot testing.

Pilot testing will be done in several first grade classrooms during the second half of the 1974 school year, and will be extended to second grade during the 1975 school year. During 1975, materials used in pilot testing will be revised and wide-scale daily broadcasting of first grade lessons will begin in August 1975. Second-grade lessons will be broadcast in the 1976 school year, and in ensuing years the same pattern of pilot testing, revision, and later wide-scale implementation will be followed for the remaining grades during the lifetime of the project. The termination date of AID funding is currently June 30, 1977. Any possibility of extension of this Agreement would depend on a joint decision of AID and the Nicaraguan Government.

V. RESPONSIBILITIES OF THE PARTIES

A. The Ministry hereby agrees to carry out its responsibilities in support of this Project by providing the following:

1. From June 1, 1974

   a. The Ministry will make available schools and personnel who will cooperate in this experimental project.
   b. Office space in the Institute of Masaya.
   c. Some equipment (typewriter) and office furniture.
   d. Use of Ministry audio-visual aids facility.
   e. Use of Ministry printing facilities.
   f. Personnel
      (1) three senior staff members
      (2) three teachers
      (3) one secretary
      (4) one driver
   g. Use of recording facilities.

2. From January 1, 1975

(In addition to those items listed in A 1 Part V above the following:)

a. Radio broadcasting facilities
b. Personnel
   (1) author of children's books
   (2) teacher training counterpart
   (3) research and evaluation counterpart
   (4) radio-producer-director
   (5) an additional secretary
   (6) one radio technician

B. AID hereby agrees to carry out its responsibilities in support of this Project by providing the following through a contract with Stanford:

In Nicaragua:

1. Technical services, including:
   (a) Two Stanford senior staff members who will serve as Project Director and Director of Research and Evaluation
   (b) If needed, one Stanford radio specialist
   (c) Computer programming services (either local or through Stanford)
   (d) Consulting services

2. Supplies, equipment and services, including:
   (a) Office machines (primarily typewriters, desk calculator, mimeograph machine)
   (b) Stationery supplies, postage, telephone costs
   (c) Printing materials (paper and ink) and overtime labor costs, if Ministry facilities used. However, if Ministry facilities are not used Stanford will provide funds for the production cost of the teaching materials.
   (d) Graphic arts supplies and materials and overtime labor costs if Ministry facilities used.
   (e) Vehicles--purchase, maintenance, gasoline
   (f) Radio receivers--purchase, batteries and maintenance
   (g) Tape recorders--purchase, maintenance and tapes
   (h) Rental of key punch, salary of key punch operator
   (i) Computer services, supplies--magnetic tapes, punched cards
   (j) Cost of radio production--personnel and supplies

3. Training:
   (a) In-service training in Nicaragua of personnel connected with the project
   (b) Training of one Nicaraguan a year, at Stanford University in areas related to this project.

At Stanford:

Technical services, including:
(a) Principal investigator, part-time
(b) Project coordinator
(c) Secretary 1/2 time
(d) Research assistants as required
(e) Computer time

APPENDIX E

Flowcharts for Curriculum Production

The flowcharts in Figures 1, 2, and 3 illustrate the process of producing a single radio lesson. The major functions described are those of the curriculum designer, curriculum writer, curriculum editor, scriptwriter, script editor, and producer-director. Other functions described require a translator, and radio technicians and other technical support staff. The collection and analysis of data also enter the description of tasks. The flowchart shows each of these functions separately. For the initial stage of operations in Nicaragua, project personnel will share among themselves the major roles in the following way.

Curriculum designer:	Project director, assisted by the campus coordinator and the assistant project director
Curriculum writer:	Nicaraguan curriculum writer, assisted by the assistant project director
Scriptwriter:	Radio specialist, assisted by the project director and the assistant project director
Curriculum editor:	Project director
Script editor:	Radio specialist
Director-producer:	Radio specialist

As the staff expands and Nicaraguan counterparts are trained, the activities described in the flowchart will be shared among a larger number of people.

Lesson production starts with the preparation of an outline of the mathematical content for the entire set of projected lessons.

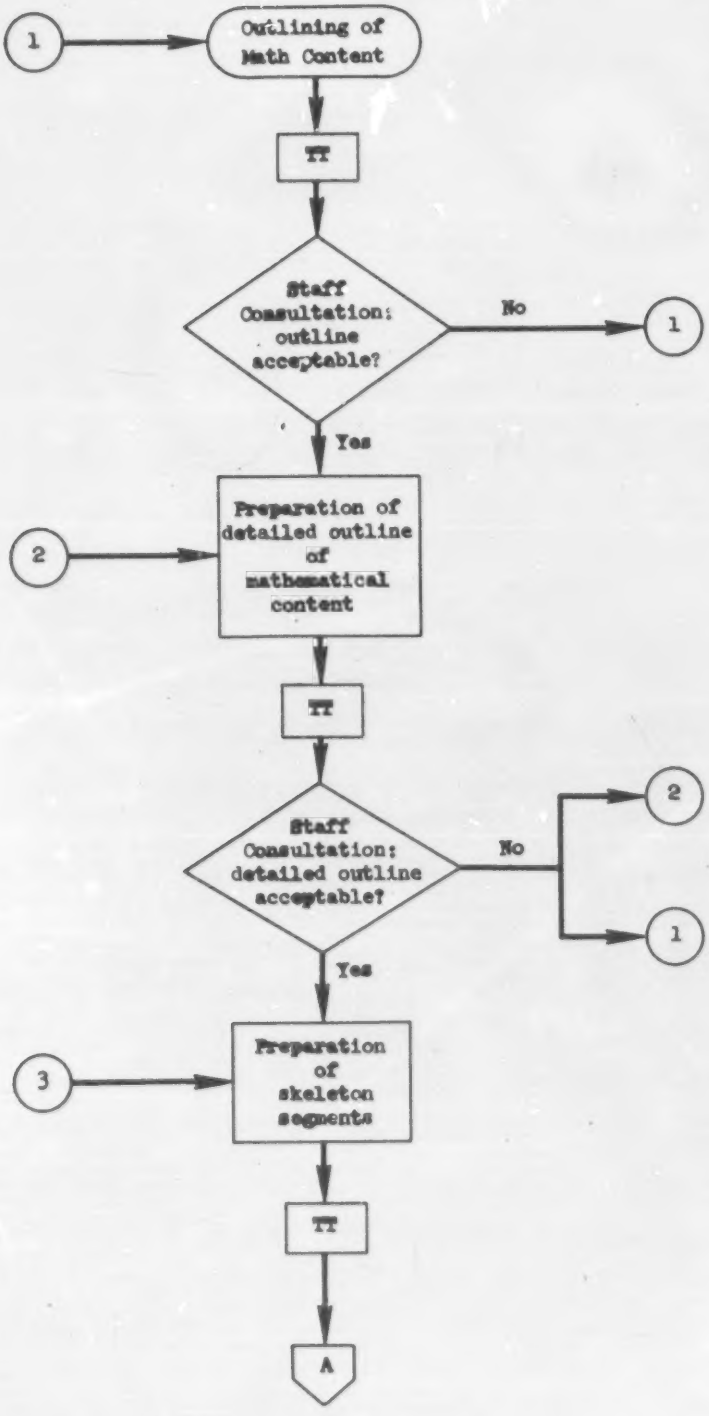

Figure 1. Production flowchart for design and implementation of the curriculum depicting feedback mechanism.

T indicates written material that must be typed (or retyped) before next stage. TT indicates written material that must be typed in first language, translated, and typed in second language.

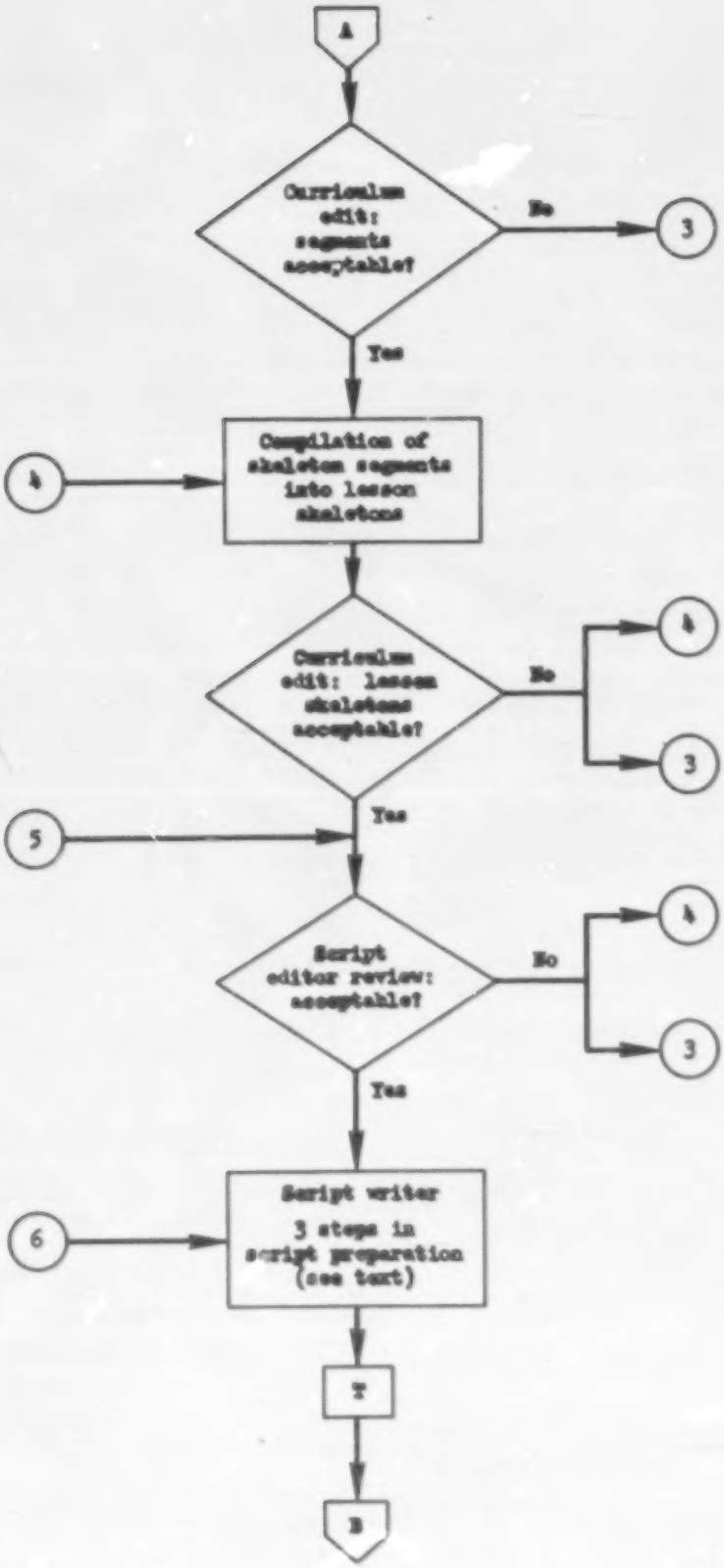

Figure 1 (continued)

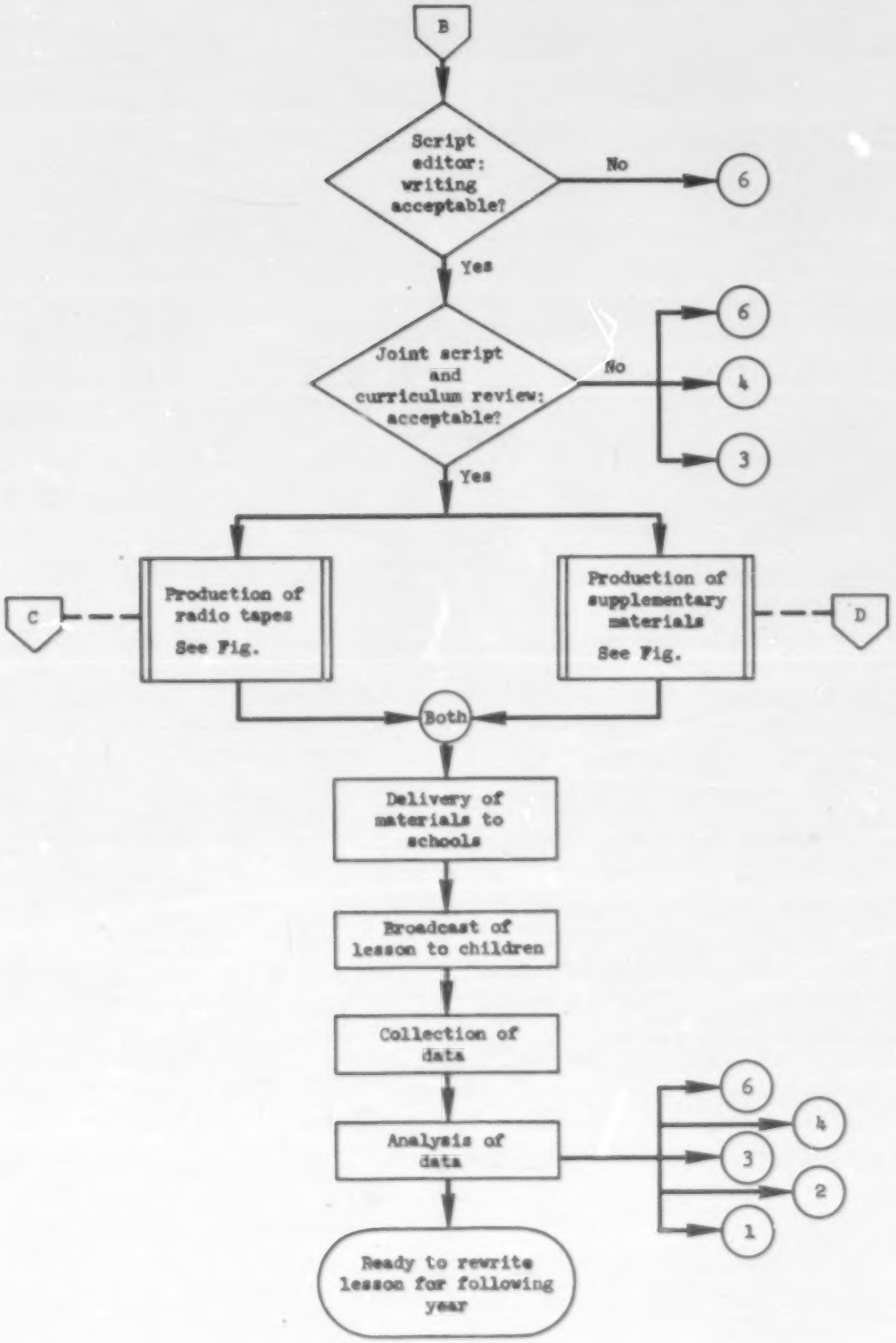

Figure 1 (continued)

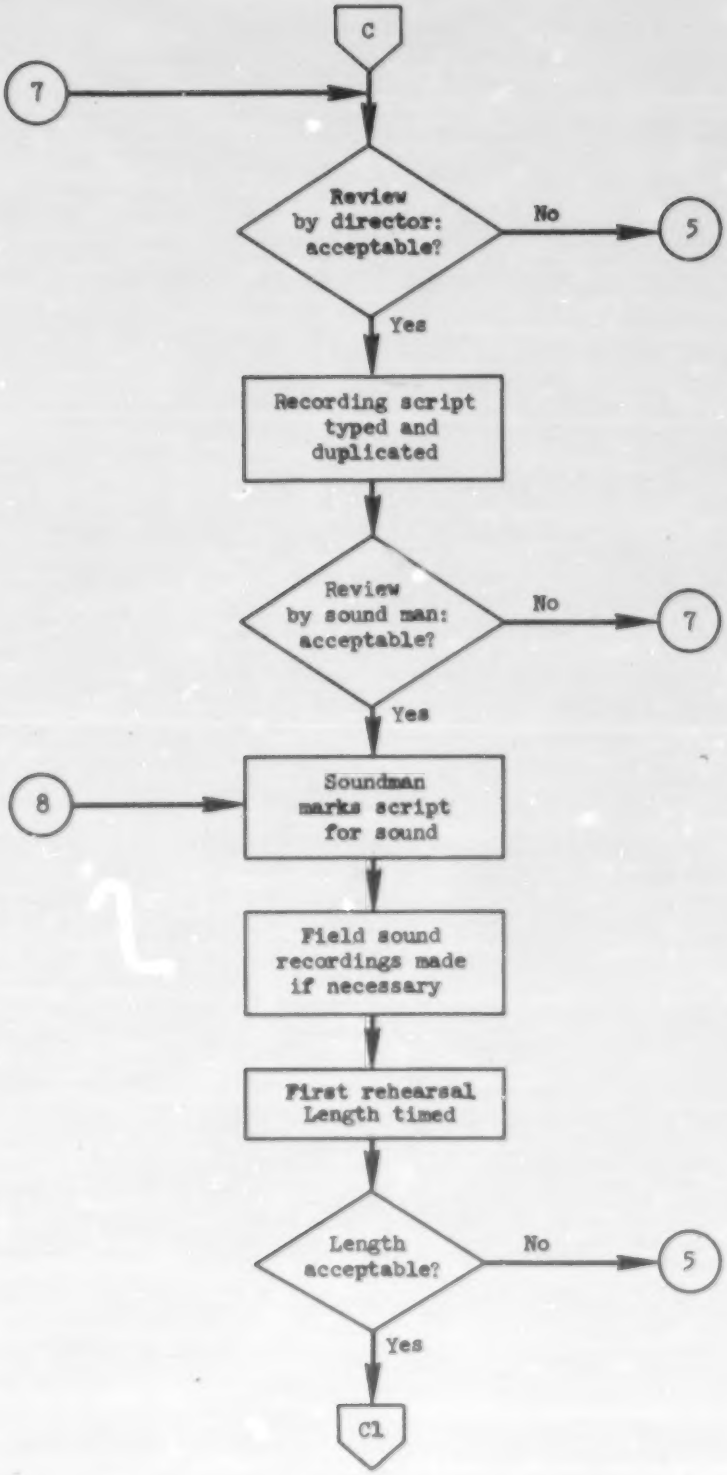

Figure 2. Production of radio tapes.

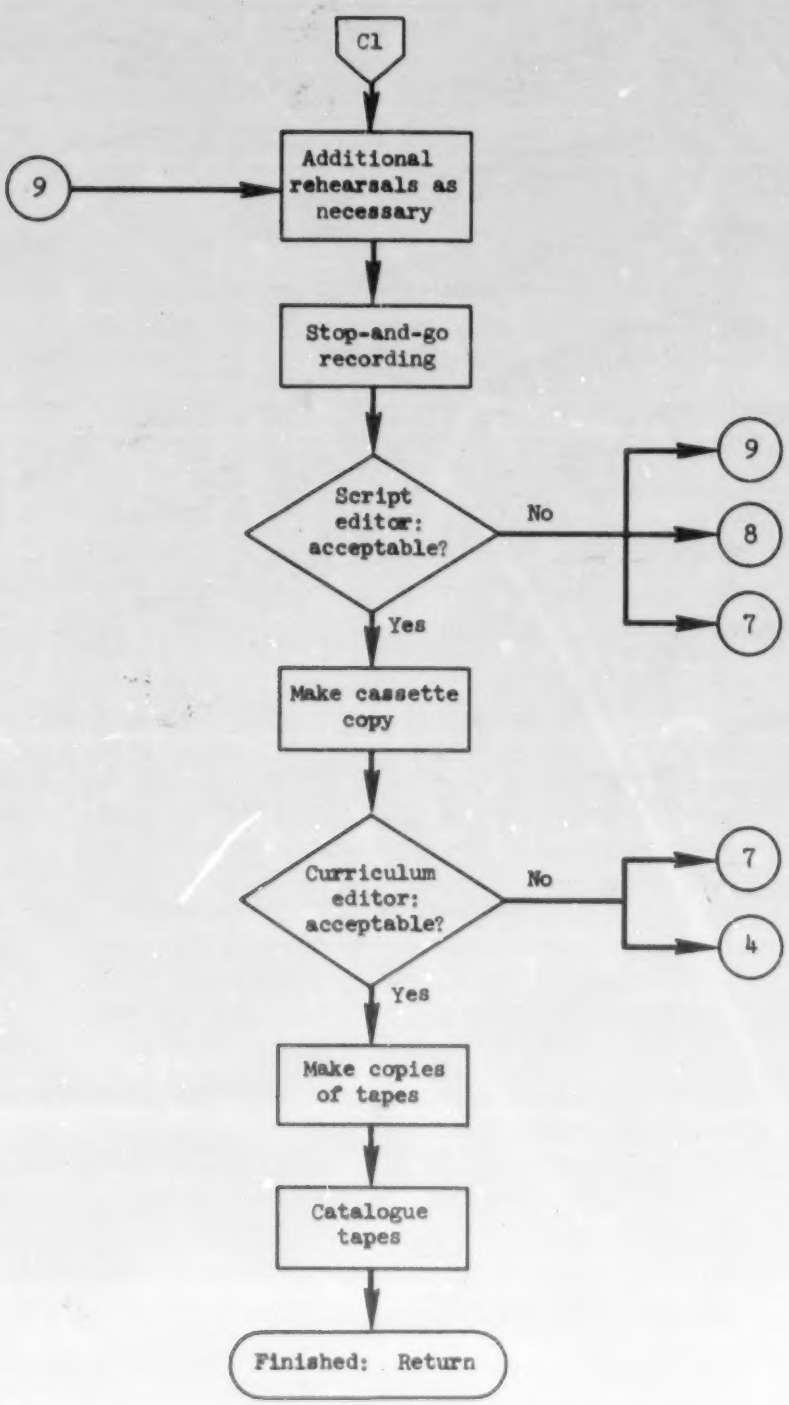

Figure 2 (continued)

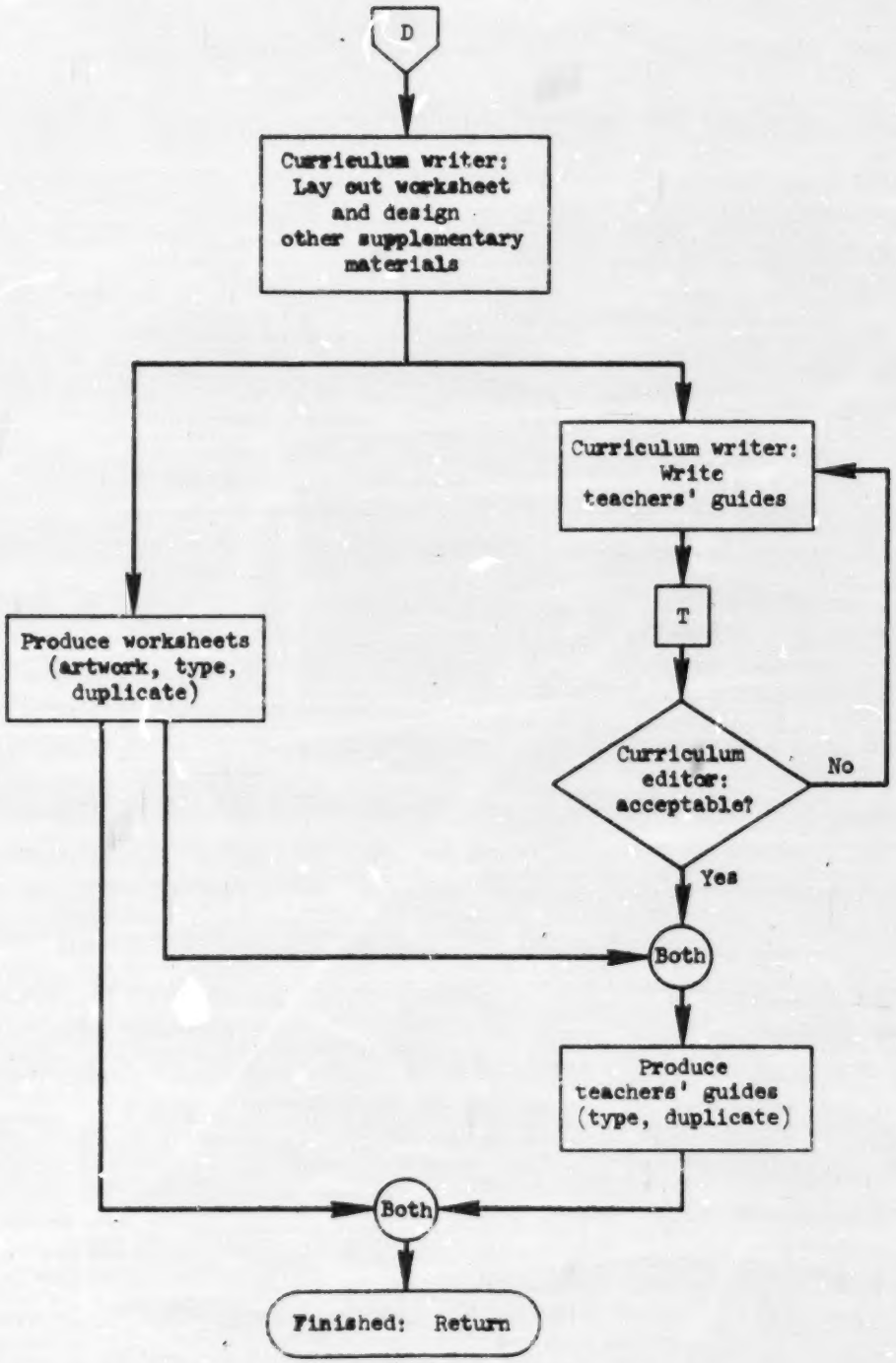

Figure 3. Production of supplementary materials

In general, this outline will cover the curriculum for an entire school year and will specify the topics to be covered and, within each topic, the concepts and skills to be taught. The outline will be reviewed by all staff members who are concerned with curriculum, and in particular, by the Nicaraguan curriculum specialists, who must verify that the proposed curriculum conforms to the guidelines set by the Ministry of Education. Necessary revisions will be made (return to 1 in the flowchart), followed by review. This process will be repeated until an acceptable curriculum outline has been formulated.

Then follows the preparation of a detailed outline of mathematical content, specifying along a time axis the instructional sequences within each topic, the interrelationship of topics, the amount and position of reviews, and so on. The ensuing staff review can uncover either deficiencies in the original outline (return to :) or inadequate specification of details (return to 2).

The next task is the preparation of skeleton lesson segments. A lesson segment, as presently conceived, is a single instructional sequence, comprised of an instructional strategy and associated exercises, or a set of drill exercises, or a set of review exercises. A skeleton segment specifies mathematical content without supporting contextual material (dialogue, story line, and so on). Skeleton segments covering the entire detailed outline are prepared (step 3) and reviewed. These are then compiled into lesson skeletons (step 4). We anticipate that this process may require reorganization of the skeleton segments, and perhaps some reassessment of the contents of the detailed outline.

The curriculum design will be written first in English and then translated into Spanish for review and implementation. All translation

work will be supervised by the assistant project director, who is a Nicaraguan mathematics curriculum expert and bilingual. Scripts and printed materials for teachers and students will be written in Spanish. Such translations into English as are necessary for analysis and reporting purposes will be carried out separately and are not considered part of the lesson production process.

The process of curriculum organization, as described thus far, has been carried out on a small scale for the preparation of five sample radio lessons that were written, produced, and pilot-tested at Stanford during the spring of 1974.

The work leading to 5 will have been completed before the preparation of any lessons. From 5 on, the flowchart describes the production of a single lesson. The work on a lesson starts with the review by the script editor of the lesson description represented by the compilation of lesson segments. This review takes place immediately before work on the lesson begins, so that the script editor can make use of experience gained during earlier work to evaluate the proposed lesson. If necessary, the editor sends the proposed lesson back to 4 for reworking.

The scriptwriter must attend to three aspects of lesson preparation, which are to (a) write dialogue, (b) specify teacher activities during the broadcast and write the necessary instructions to the teacher, and (c) design the format of the student worksheet that will accompany the lesson. Upon the scriptwriter falls the responsibility for unifying the content prescribed by the lesson description so as to produce a coherent lesson.

The script editor reviews the completed script and if the

writing needs improvement returns the script to 6 . Then the script editor and the curriculum editor jointly examine the script, finding, perhaps, that the lesson structure is faulty (return to 4), that one or more of the lesson segments is poorly conceived (return to 3), or that further script changes are needed (return to 6).

When an adequate script has been prepared, the production of the radio tape and the production of supplementary materials may proceed simultaneously. These procedures, which are relatively straightforward, are illustrated in Figures 2 and 3.

Approximately a week before a lesson is scheduled for presentation to a class (by cassette if it is being pilot-tested, by radio thereafter), supplementary materials are delivered to the classroom. Then the lesson is broadcast and the data (student worksheets, classroom observations, teachers comments) are collected and analyzed. The results of both short-term and extensive data analysis are fed back into the lesson production process, at the level of curriculum design, (1 , 2 , 3 , 4), and lesson writing (6), and may influence the production of subsequent lessons during the year, or the rewriting of the lesson the following year.